Creation Research
Society Quarterly

Haec credimus:
For in six days the Lord made heaven and earth, the sea, and
all that in them is, and rested on the seventh. — Exodus 20:11

VOLUME 33 DECEMBER 1996 NUMBER 3

CHARCOAL AND CATASTROPHISM IN THE DAKOTA FORMATION, NEWCASTLE, WYOMING

CREATION RESEARCH SOCIETY

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The charcoal in this boulder from the Dakota Formation at Newcastle, Wyoming, is mixed within the rock rather than being confined to bedding planes, indicating a catastrophic deposition according to Edmond W. Holroyd, pp 170-175. The linear features may be bark impressions. Charcoal weathered from other rocks litters the background. Photo by Edmond W. Holroyd, III.

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CREATION RESEARCH SOCIETY

History The Creation Research Society was organized in 1963, with Dr. Walter E. Lammerts as first president and editor of a quarterly publication. Initially started as an informal committee of 10 scientists, it has grown rapidly, evidently filling a real need for an association devoted to research and publication in the field of scientific creation, with a current membership of over 600 voting members (with graduate degrees in science) and over 1100 non-voting members. The *Creation Research Society Quarterly* has been gradually enlarged and improved and now is recognized as the outstanding publication in the field.

Activities The society is solely a research and publication society. It does not hold meetings or engage in other promotional activities, and has no affiliation with any other scientific or religious organizations. Its members conduct research on problems related to its purposes, and a research fund is maintained to assist in such projects. Contributions to the research fund for these purposes are tax deductible. The Society operates The Van Andel Research Center in Chino Valley, Arizona.

Membership Voting membership is limited to scientists having at least an earned graduate degree in a natural or applied science. Dues are $22.00 ($27.00 foreign) per year and may be sent to Glen W. Wolfrom, Membership Secretary, P.0. Box 8263, St. Joseph, MO 64508-8263. Sustaining membership for those who do not meet the criteria for voting membership, and yet who subscribe to the statement of belief, is available at $22.00 ($27.00 foreign) per year and includes a subscription to the Quarterlies. All others interested in receiving copies of all these publications may do so at the rate of the subscription price for all issues for one year: $25.00 ($30.00 foreign).

Statement of Belief Members of the Creation Research Society, which include research scientists representing various fields of successful scientific accomplishment, are committed to full belief in the Biblical record of creation and early history, and thus to a concept of dynamic special creation (as opposed to evolution), both of the universe and the earth with its complexity of living forms. We propose to re-evaluate science from this viewpoint, and since 1964 have published a quarterly of research articles in this field. All members of the Society subscribe to the following statement of belief:

1. The Bible is the written Word of God, and because it is inspired throughout, all its assertions are historically and scientifically true in all the original autographs. To the student of nature this means that the account of origins in Genesis is a factual presentation of simple historical truths.

2. All basic types of living things, including humans, were made by direct creative acts of God during the Creation Week described in Genesis. Whatever biological changes have occurred since Creation Week have accomplished only changes within the original created kinds.

3. The Great Flood described in Genesis, commonly referred to as the Noachian Flood, was a historical event worldwide in its extent and effect.

4. We are an organization of Christian men and women of science who accept Jesus Christ as our Lord and Saviour. The account of the special creation of Adam and Eve as one man and woman and their subsequent fall into sin is the basis for our belief in the necessity of a Savior for all people. Therefore, salvation can come only through accepting Jesus Christ as our Savior.

President's Remarks

May I wish all of our members and friends a very merry Christmas. 1996 has been a good year for the Society as we continued, with your help, to publish the Quarterly, various books and the newsletter. A new well-written monograph on glaciation by Michael Oard is soon to be released. There are other monographs on a variety of topics in production. Our research and field work is progressing at a reasonable rate. Reports of these efforts eventually will be published in the Quarterly or as separate monographs. Many members correspond with us, suggesting research projects near their home. As a matter of fact, we are into field study in Virginia as a result of the interest of one of our members, Henry Mitchell.

The number of Quarterly pages per issue has been increased to allow for the large number of available manuscripts. I am gratified by your interest. Creationism is a growing movement. Many creationist scientific journals, conferences and local organizations add vigor to our cause. May we strive together to improve the creation model of science. In a world that seemingly has lost its direction, our message and interpretation of science are needed. May God grant us wisdom.

I have been impressed by the content of the Quarterly this year. I applaud the efforts of our editors, authors, peer reviewers and proofreaders. Each of you offered a totally voluntary, positive contribution to the Society. The complexity of the task is daunting, but by God's grace, it was accomplished. I hope many of you will submit manuscripts on creationist topics to be considered for publication.

The outpouring of creationist geology writings in recent years has been phenomenal. Many different Flood models are under consideration and various views on many geologic topics have been offered. It was gratifying to see Dr. Henry Morris active again and writing in defense of his Flood model. Such subjects as what part will the uniformitarian geological column play in creationist geology, where is the Flood / post-Flood boundary in the geologic column, and the very nature of the Flood itself are being debated in creationist circles. This is a good sign of the healthy growth of our cause as long as we do not stray into pseudoscientific, antiscriptural positions. Differences in interpretation abound at the moment. I look forward to future discussions in the Quarterly.

Several authors have called and written to me concerning occasional vicious comments received from some peer reviewers. The authors were willing to accept criticism, but the cruelty of the remarks were deemed unnecessary. One would hope that creationists would be more charitable with each other. Often the remarks deal with differences in interpretation, not with scientific flaws. There will be continual interpretative differences as creationists offer models in an attempt to account for certain physical, biological and geological events and processes. I trust that these exchanges will become less inflammatory in the future.

Over the years, I have benefited *greatly* from peer review comment on my manuscripts and I readily ask for help. It is often difficult on the ego, but in the end, the advantages of the process far outweigh the disadvantages. When I was editor of the Quarterly, many submitted manuscripts were strengthened as a result of the work of reviewers. As I look back on my years as an active creationist, I am grateful to so many people who have helped me with my work. Likewise, to those of you who continue to help the Society in many ways, thank you very much.

Our annual Board of Directors meeting will be held in Albuquerque, New Mexico, April 10-12, 1997. The public meeting will be Friday evening, April 11. Why not come and join us at that time? It would be a pleasure to meet you.

Emmett L. Williams

LETTER TO THE EDITOR

Historical Seismic Activity in Florida

While conducting research for a historical account of earthquakes along the U.S. Gulf Coast, I stumbled across an interesting error that geologists had made, and have continued to perpetuate over the years. A number of geological treatises dealing with seismic activity in Florida list two earthquakes occurring in Pensacola, Florida: a mild one in February of 1780 and a second quake of greater severity on May 8, 1781 (Florida Department of Community Affairs, 1994, p. 83; Lane, 1976, p. 6; Lane, 1991, p. 9; Lane, 1994, p. 53; Mott, 1983, p. 117; Smith and Randazzo, 1989, p. 2-41). I was able to trace the February 1780 account to historical sources (Campbell, 1892, p. 110; Eelking, 1977, p. 21). But no evidence at all existed for the May 8, 1781 quake. By tracing back the geologists' source for this 1781 account, a valuable lesson can be learned. The geologists who were reporting the 1780 earthquake, and a more destructive 1781 earthquake, were citing Richard Campbell's 1892 book on the history of colonial Florida (Campbell, 1892), in which the author writes:

"The earthquake, too, that visited [Pensacola] on the night of February 1780, was but a presage of that which on May 8, 1781, was to shake it to its center; and prove the signal of an exodus of the English almost as complete as was that of the Spanish population in 1763" (Campbell, 1892, p. 110). The geologists made a simple mistake; they did not know their Florida or Pensacola history and they failed to recognize Campbell's use of literary license. Campbell is not talking about a *physical* earthquake on May 8, 1781. He is alluding to the *military/political* earthquake of that date—the day that Spanish military leader Bernardo de Galvez captured Pensacola from the British. (Parks, 1986, p. 36). This is a good example of how easily scientists can be misled, and then cite erroneous information until the idea is perpetuated in the scientific literature. One wonders how many similar errors are in other scientific treatises, perhaps many bearing on the supposed "fact" of evolution.

References

Campbell, Richard L. 1892. Historical sketches of colonial Florida. Reprint, 1975. University Press of Florida. Gainesville.

Florida Department of Community Affairs. 1994. State of Florida hazard mitigation plan. Florida Department of Community Affairs, Division of Emergency Management. Tallahassee.

Lane, Ed. 1976. Earthquakes in Florida? *Florida Conservation News* 11:6.

____________. 1991. Earthquakes and seismic history of Florida. Open File Report No. 40. Florida Geological Survey. Tallahassee.

____________. 1994. Florida's geological history and geological resources. Special publication No. 35. Florida Geological Survey. Tallahassee.

Mott, Charles J. 1983. Earthquake history of Florida: 1727 to 1981. *Florida Scientist* 46:116-120.

Parks, Virginia. 1986. Pensacola: Spaniards to space age. Pensacola Historical Society. Pensacola.

Smith, Douglas L. and Anthony F. Randazoo. 1989. History of seismological activity in Florida: Evidence of a uniquely stable basement. In: Proceedings of the second symposium on current issues related to nuclear power plant structures, equipment, and piping with emphasis on resolution of seismic issues in low-seismicity regions. Electric Power Research Institute. Palo Alto.

von Eelking, Max. 1977. German mercenaries in Pensacola during the American revolution, 1779-1781. *Pensacola Historical Society Quarterly* 9:1-36.

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Editors' Comments

This issue of the *Creation Research Society Quarterly* has a varied and rich range of subjects reflecting the increased interest in creation worldviews that we have been experiencing recently. In keeping with tradition, all articles and Panorama Notes accepted for publication are subjected to peer review. The editor obtains the opinions of the peer reviewers as a precaution to ensure that the material in the Quarterly is technically correct, and that it conforms to the type of subject matter that is appropriate for a Creation Research Society publication. However, the viewpoints expressed in the articles are often those of the authors and not necessarily those of the editors, of the CRS Board, or of the members in general. For example, in this issue we have an article by five authors, with impressive credentials, which urges caution with respect to the adoption of plate tectonics paradigms within young-earth creationism. While most would agree that caution is necessary, there are other authors, with impeccable credentials, who are more in favor of adopting catastrophic plate tectonics models, within the young-earth framework.

Three other full-length articles in this issue treat the sedimentation process within catastrophic models involving the Genesis Flood. The article by Dr. Edmond Holroyd, III involves detailed field work studying the deposition of charcoal together with sand and other sediments, and possible explanations which seem to require rapid processes. Two Russian geologists offer a mathematical study of the time scale involved in the deposition of tin placer deposits, principally on the Arctic coast of Russia. In the same vein, Dr. Larry Vardiman offers a study of process rates for the deposit of sediments on the ocean floor, together with data indicating the temperatures of the water over time. All three of these articles provide evidence that the young-earth time frame is capable of handling these data.

Geologist Dr. John Reed continues his series on the philosophical basis of creation-oriented geology. Readers will appreciate the way he points out the features of the geological record which the creation record can explain.

Dr. Jerry Bergman, in his typically thorough and wide-ranging style, provides an interesting study of how the origin of sex is better explained by invoking a designer than by appealing to a random process of selection pressures.

Other short features, too numerous to mention, are included in this issue, and we hope that the increased interest in contributing to the creation viewpoint will continue. We also trust that the readers and the authors of the *CRS Quarterly* will redouble their efforts to promote this magazine because it contains scientific evidence supporting the belief that God created many separate kinds, that He did this with amazing rapidity, and that He did so quite recently. Our attempts to stand for God's truth in origins can be very important at a time like this when even religious leaders are capitulating needlessly to evolutionism.

Eugene F. Chaffin
George F. Howe

IN MEMORIAM — JOHN W. KLOTZ

January 10, 1918-April 11, 1996

The Society, as well as the entire Creation community, has lost a scholar and a man of enormous and versatile talents at the passing of our Christian friend, John W. Klotz. He was one of team of 10 original founding members of the Society in June of 1963. John remained on the Board for nearly 30 years until the age of 75 in 1992. During this time, he authored numerous papers and served the Society as Treasurer from 1985 to 1986, as Financial Secretary from 1987 to 1988, and on the Employment Bureau from 1979 to 1989. He was elected a Fellow of the Society in 1988. The March 1989 *Creation Research Society Quarterly* was dedicated to Dr. Klotz.

John was one of the first of a generation of Missouri Synod Lutheran professors and theologians who achieved a doctorate in science. He graduated from Concordia Seminary, St. Louis, Missouri, in 1941. He received the Ph.D. in genetics from the University of Pittsburgh in 1947 and engaged in further graduate studies at Washington University, St. Louis, Missouri and the University of Minnesota in Minneapolis. For his outstanding work in the service of the Lutheran Church-Missouri Synod, he was awarded the honorary Doctor of Divinity degree in 1986 by Concordia Theological Seminary, Ft. Wayne, Indiana.

John was a teacher all his life, serving in no less than five secondary schools, colleges, universities and seminaries. He taught science courses in biology, zoology, botany, biophysics, bioethics, and ecology. His outstanding books on creation include *Genes, Genesis and Evolution* (1955, 1970), *Modern Science in the Christian Life* (1961), *The Challenge of the Space Age* (1961), *Ecology Crisis* (1971), and *Studies in Creation* (1985). He is also coauthor of the CRS booklet *Did Charles Darwin Become a Christian?*

A humble and kind scholar in both science and theology, John always found time to help others in a most busy schedule, a rare trait in today's world. He was there to listen as a Christian friend. Although I did not meet him until I attended Concordia Seminary in the late 1980's, he had served as one of my mentors in the matter of creation since high school when I purchased and continually used his outstanding book *Genes, Genesis and Evolution.*

As a Missouri-Synod Lutheran scholar and pastor, John served at Concordia Seminary, St. Louis from 1974 to 1988 when he retired. He served as a wise counselor and a man of integrity during those years when the literalness of Genesis was being questioned and doubted by fellow Lutherans. His one wish and desire was to see that his Church stayed true to Scripture in matters of creation as well as other doctrines. God used this kind and gifted man mightily to do this.

In the introduction to his book *Genes, Genesis and Evolution,* he stated a premise he ably defended during his entire life:

> It is the author's thesis that evolution in the generally accepted sense of the term has not taken place. He does not believe that life as we know it is the result of a gradual process of development, that man, for instance, is the descendant of simple, unicellular forms. . . . This is not to deny the fact of change. . . . But all of this change, insofar as the organic world is concerned, has taken place within limits fixed by the Creator when He fashioned the different 'kinds' in the beginning. (p. vi.)

Yet, in spite of his intelligence, his many prestigious positions through all the years, his well-earned reputation and capabilities, John gave the glory to Jesus Christ, his Savior and Lord. John firmly held forth the God of Scripture as the Creator and Redeemer. He is survived by his wife of 53 years, Florence, their four surviving sons and three daughters and their families as well as by his many friends and acquaintances. A fifth son preceded his father in death. He who was never ashamed of proclaiming the Biblical truths of creation is now with His Creator. John set a marvelous example of dedication to the fundamental truths of Scripture and of civility. We thank you, Lord, for all You accomplished through John's long and productive life!

Robert E. Gentet

Comments from a Colleague

John Klotz is the reason I am active in the creation movement. When I was a mixed-up undergraduate at a state college, I read his books, *Modern Science in the Christian Life* and *The Challenge of the Space Age.* They convinced me that all the evolutionistic teaching I was getting in my courses was not only untrue and unscientific, but deceitful and harmful to the Church and society. Although I never studied under him, I met him at Church conventions. He urged me to publish articles on Creation which I did. He became my mentor as we both served on the Board of Directors of the Creation Research Society for many years. Many times when I needed advice, he was the man I phoned. His counsel was always deliberate, clear, Biblical and evangelical. I thank my Creator, Savior, and Comforter for leading me to know John Klotz. I only hope I may, in some way, carry on the tradition and example he set.

David A. Kaufmann, Ph.D.

A THEORY FOR THE VOLCANIC ORIGIN OF RADIOACTIVE SHALES AND CLAYS: EXAMPLES FROM THE SOUTHEASTERN UNITED STATES

CARL R. FROEDE JR.*

Received 2 November 1994; Revised 28 September 1995

Abstract

An explanation is offered, within the young-earth Flood model, for the origin of radioactive shales and clays via the alteration of volcaniclastic material (ash deposits) which contain radioactive elements. This is based on the similarity of radioactive elements identified as leaching from altered volcanic ash deposits in the western United States. The Southeastern United States has many marine organic rich "black" shales, massive clays, and sandstone layers which contain radioactive elements at levels significantly higher than the surrounding strata. The radioactivity associated with those clastics is derived from several radioactive isotopes including uranium (^{234}U), thorium (^{232}Th), potassium (^{40}K), and radium (^{226}Ra). Two specific stratigraphic units, the Chattanooga Shale of Tennessee and various clay units within the massive clastic deposits of the Hawthorn Group of west central Florida, are proposed as examples where radioactive volcaniclastics have altered in-situ to yield radioactive shales, clays.

Introduction

The uniformitarian model proposes that clastic sediments have been generated through weathering processes which have operated over vast eons of time. Weathering of the continents, over the millions of years suggested, have resulted in the generation of sands, silts, and clays which were transported to former seas and oceans. It is in this marine setting where only certain silts and clays became radioactive. Suggested mechanisms include the direct precipitation of uranium salts, bioaccumulation by organisms, adsorption by clay or organic matter, or derivation from "hypothetical" radioactive heavy minerals derived in turn from igneous intrusives of the adjacent highlands, which were deposited within the fine-grained clastics. We will examine these many theories, along with one which fits within the young-earth Flood model, in an attempt to determine how these layers became radioactive.

It has been estimated that shales comprise 82 percent of all sedimentary rocks on Earth and that they contain the largest concentrations of radioactive substances (Beers, 1945, p. 2). Many studies have investigated various radioactive clays and shales found in the Southeastern United States (Bell, Goodman, and Whitehead, 1940; Sheppard, 1944; Beers and Goodman, 1944; Beers, 1945; Cathcart, 1950; Swanson, 1960). Most of these have been undertaken in an effort to locate valuable petroleum and mineral deposits. The origin, nature, and extent of the radioactivity of the shales and clays has remained, for the most part, unaddressed.

Uniformitarian weathering processes suggest that the earth has undergone billions of years of long-term uplift and erosion, with the eroded sediments slowly filling subsiding basins. Within this framework, exposed land surfaces eroded toward total peneplanation until diastrophic (i.e., tectonic) activity created new highlands. The sediments derived from this cycle then imply the millions of years required (using today's hydrologic cycle) to accommodate the uniformitarian time frames.

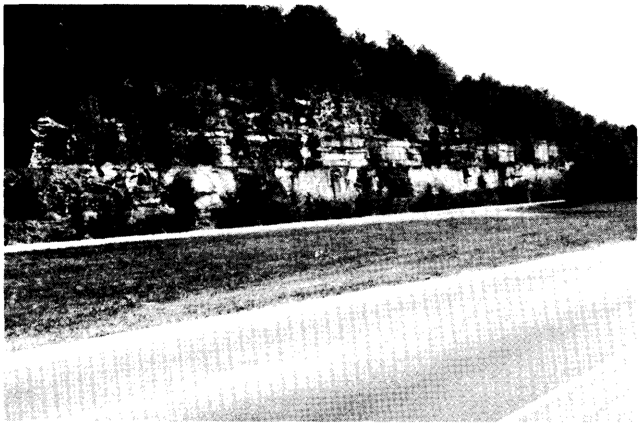

Figure 1. Chattanooga Shale as exposed along Interstate 40 approximately 15 miles west of Nashville, Tennessee.

According to Uniformitarians, the vertical stratigraphic section of Southeastern United States reflects many millions of years of eustatic sea-level changes resulting in the deposition of certain sequences of sediments which can be further subdivided into lithologic facies, all of which can be understood in terms of the concepts of sequence stratigraphy (Froede, 1994a). These facies are then used to identify the original environment(s) in the vertical sequence, using concepts such as Walther's Law. This conceptual model of facies development (e.g., deltas, barrier complexes, estuarine settings, meandering river complexes, etc.) over the vast periods of time in which they are purported to have existed (i.e., millions of years), is used to support the uniformitarian model. Although the recognition of catastrophic processes is gaining support among many of the uniformitarian geoscientists, it is still used within their time frames of millions of years.

The I believe that there is a major disconnect between the facies concept and the original source(s) of those sediments. Uniformitarians suggest that the sediments which compose the present day southeast were derived from a variety of sources, including mountain ranges (e.g., Appalachians, Ouachitas), localized areas of uplift (e.g., Cincinnati Arch, Nashville Dome, Ocala Arch, Hatchetigbee Anticline), biogenic rock sources (e.g., carbonate producers), and reworked "older" deposits. However, most of these original sediment source areas, which are suggested as supplying sediments over millions of years, remain ambiguous and vague. For example, the issues of when, what types of materials

---

*Carl R. Froede Jr., B.S., P.G., 2895 Emerson Lake Drive, Snellville, Georgia 30278-6644.

and how much sediment they contributed to the southeastern stratigraphic section have, in most cases, not been addressed.

The young-earth Flood model also requires that we identify the sources of the sediments identified in the Southeastern United States. This paper proposes that one commonly overlooked major source of sediments is from volcanic activity which was initiated during the Flood. These volcaniclastics compose significant amounts (i.e., both by volume and in areal extent) of sediments in the Southeastern United States vertical stratigraphic section. Additionally, the author recognizes that other sediments were added to the southeastern stratigraphic section from the sources previously mentioned (i.e., mountains, areas of uplift, biogenic activity, and reworked deposits). The major difference between the uniformitarian and young-earth Flood models is in the amount of time available to construct the southeastern vertical stratigraphic section (i.e., either within the course of millions of years or within a few thousand years).

Identification of Volcanically Derived Sediments

It is now well documented that past volcanic events have contributed significant amounts of pyroclastic sediments to the stratigraphic record (e.g., Huff, Bergstrom and Kolata, 1992; Lockley and Rice, 1990; Rice, 1990; Axelrod, 1981; Fisher and Smith, 1991; Rampino, 1991; Carey, 1991; Smith and Lowe, 1991; Donn and Ninkovich, 1980; Kennett and Thunell, 1975; Ross, 1928; Ross, 1955). The contribution of pyroclastic rock to the sedimentary record is probably greater than currently understood, because an unknown amount of fine grained tephra is largely unrecognized in rocks classified as shale (Fisher and Schmincke, 1984, p. 5; Ross, 1955, p. 427; Grim, 1958, p. 252; Weaver, 1963, p. 343; Pettijohn, 1957, p. 153). Volcanism is recognized as having occurred in the geologic past in the Southeastern United States (Byerly, 1991). However, the level of volcanic activity is generally viewed by Uniformitarians as being rather small in scale due to the limited lateral extent and volume of "recognized" volcaniclastic sediments.

Radioactivity In Shales, Petroleum, Coals, and Clays

As a result of petroleum exploration, many radioactive shale and clay layers have been identified in the Gulf Coastal Plain (Bell, Goodman, and Whitehead, 1940, pp. 1540-1542; Levorsen, 1967, pp. 527-529). Many scientists have investigated the possibility that radioactivity was responsible for the origin of petroleum deposits; their results, however, were inconclusive (Sheppard, 1944; Landes, 1976, pp. 165-167; Whitehead, 1954).

Russell (1945) examined the radioactivity of 510 samples of sedimentary rock from the subsurface of the Gulf Coastal Plain and found that marine shales are highly radioactive as compared with other sediments. Additionally, he found that Paleozoic shales display higher radioactivity levels than do the Cenozoic shales (Russell, 1945, p. 1486). Beers (1945, p. 2) found that pure limestones and quartzites exhibit practically no radioactivity, while black organic shales contain high concentrations of three principal radioactive elements (i.e., uranium, thorium, and potassium).

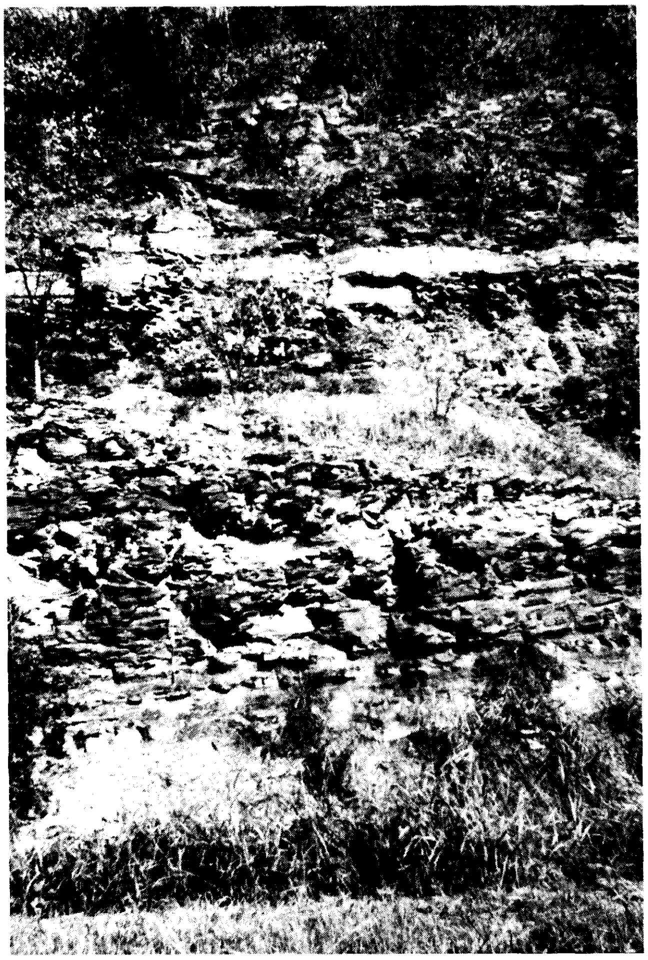

Figure 2. Closeup photograph of the Chattanooga Shale showing stratification. Scale along left side of photograph is in six inch units.

McKelvey and Nelson (1950, p. 38) have stated that nonmarine oil shales, coals, and associated black shales as a group have abnormally low uranium content.

In attempting to discuss the formation of black shales using uniformitarian processes. Arthur and Sageman (1994) revealed at least two inconsistencies in the model to explain its occurrence. First they stated that black shale; appear to be associated with marine transgressions or highstands (pp. 505, 536) and also with high rates of sedimentation (p. 514). Arthur and Sageman (1994, p. 522) relate the following when discussing the occurrence of a variety of trace elements commonly found in association with black shales:

> For many elements (Ag, As, Cd, Cr, Mo, Sb, U, V, and Zn) a sedimentary sequence more than 10 times as thick as the black shale layer has to be leached of its trace metal content with complete transfer to the black shale bed in order to account for enrichments; in general, this mechanism does not explain relatively thick sequences of trace-metal enriched black shale.
>
> Many trace metals undergo a dramatic solubility decrease at the O_2/H_2S-boundary and are removed from the water column, usually by precipitation as sulfides, and finally buried in the sediments.

> Again, this trace element enrichment may be more noticeable when sedimentation rates and corresponding dilution by terrigenous detritus are low.

Thus the exact model for the formation of marine black shales and their varied elemental content remains an enigma for geologists. No single mechanism can be found to work in all cases to explain the occurrence of the marine black shales, and many of the present models remain unsatisfactory in explaining how these deposits have formed (Arthur and Sageman, 1994, p. 541; Wignall, 1994, p. 44).

Many petroleum and coal deposits are known to contain elevated levels of various metals and radioactive elements and their "contamination" has yet to be fully explained (e.g., Levorsen, 1967, p. 190; Coleman, Crawford, and Medlin, 1986, p. 5). For example, Gentry et al., (1976) identified uranium within coalified wood, which they suggested was deposited in the wood before it turned to coal. Additionally, Breger and Schopf (1955) postulated the occurrence of germanium, uranium, vanadium, and nickel within the less than one-inch thick coal seams of the Chattanooga Shale as reflecting deposition of these metals before the wood became coal. McKelvey and Nelson (1950, p. 39) suggest that the uranium is held by the organic content of the Chattanooga Shale rather than the shale itself. Swanson (1960, pp. 5-6) investigated the occurrence of oil yield and uranium content in black shales in the Southeastern United States and concluded that the uranium was deposited with the original clays. Most of the radioactive shale and clay layers identified in the subsurface of the Southeastern United States have not been reported or investigated because of the proprietary nature in which the petroleum companies operate and because these layers are located at great depth and do not lend themselves to easy examination or exploitation.

Source of Radioactivity

Currently, there are two basic theories which are proposed by Uniformitarians to explain the occurrence of radioactive shales and clays. The first holds that marine sediments containing radioactive elements (e.g., uranium, thorium, potassium and radium) are the result of prolonged periods of exposure to seawater, and/or were located in areas of coastal upwelling (McKelvey and Nelson, 1950; Cathcart, 1950; Swanson, 1960, p. 5; Church and Bernat, 1972; Veeh, Calvert, and Price, 1974; Yen and Tang, 1977; Miller and Sutcliffe, 1985; Sweeney and Windham, 1979; Arthur and Sageman, 1994, p. 523). Although this concept has been questioned (Breger and Schopf, 1955, p. 291), it is still widely supported. These conditions are suggested to account for the higher concentrations of radioactive elements in specific shale and clay layers relative to surrounding sediments. Based on the uniformitarian timescale, however, almost all marine sediment would be exposed to seawater for millions of years and it would follow that every marine sediment should be radioactive.

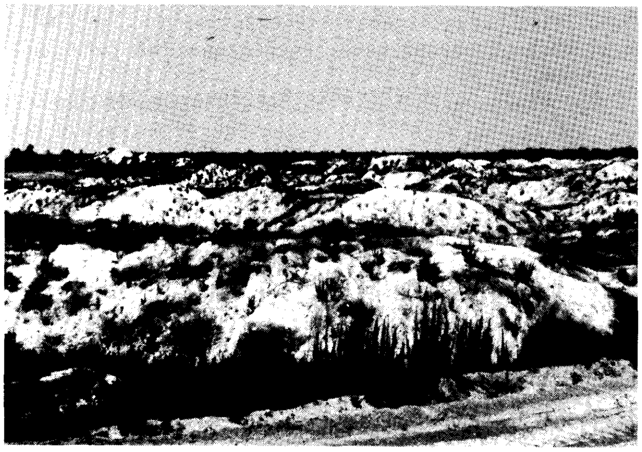

Figure 3. Phosphate mining spoil piles in mining district in Polk County, Florida.

Three modifications to the long term seawater exposure theory have been suggested: (1) uranium precipitated as salts into the sediments; (2) uranium was adsorbed by clay, organic matter, or other finely divided material; or (3) organisms served to concentrate the uranium in layers as a result of their metabolic processes (McKelvey and Nelson, 1950, pp. 44-46). All of these suggested modifications are recognized as requiring long periods of nondeposition to account for the concentrations found in the thin radioactive layers (McKelvey and Nelson, 1950, p. 41).

A second theory suggests that radioactive heavy minerals were the source for those elements found in the shales and clays. These heavy minerals were derived from igneous intrusives and metamorphic rocks from the adjacent highlands. Upon weathering the heavy minerals washed to the sea and mixed as fine particles with the marine clastics. Eventually the heavy minerals weathered away leaving high concentrations of radioactive elements (Beers and Goodman, 1944, pp. 1247-1248; Beers, 1945, p. 14; Russell, 1945, p. 1481; Sackett and Cook, 1969). With the weathering of radioactive heavy minerals, the shales and clays would then retain the radioactivity with no evidence of the original radioactive heavy minerals. However, these theories are not the only possible ways in which radioactive shale and clay sediments could have formed.

The Breakdown of Volcanic Ash

Many volcanic ash deposits have been identified as containing significant levels of radioactive elements. Daniels (1954, pp. 193-194) cites the collection of many volcanic ash deposits which were found to contain both uranium and thorium. Additionally, it was reported that acidic volcaniclastics usually contain higher concentrations of uranium (and other radioactive elements) than basic volcanic deposits (Adams, 1954, pp. 89-98). Studies performed by several scientists have shown that the alteration of a volcanic ash can yield radioactive elements (i.e., uranium [^{234}U], thorium [^{232}Th], potassium [^{40}K], and radium [^{226}Ra]). These radioactive elements can move within the groundwater until a change in the reduction/oxidation (redox) potential causes precipitation (e.g., Denson, Zeiler and Stephens, 1955; Eargle, Dickinson, and Davis, 1975; Galloway, 1978; Sherborne et al., 1979; Zielinski, Lindsey and Rosholt, 1980; and Zielinski, 1982). Bell (1954, pp. 98-114) reports the leaching and precipitation of uranium and thorium, from radioactive element containing sources, via the groundwater. Volcanic ash is now identified as the source for many uranium ore deposits in the western United States (Nations and Stump, 1981, pp. 202-203; Sharp and Kyle, 1988, p. 470; Wood and Fernandez, 1988, p. 363). According to Klein (1982, p. 42), by groundwater movement of uranium minerals:

> . . . are concentrated diagenetically at contacts where ground water flow is impeded. The ground waters responsible for such a diagenetic accumulation are highly oxidizing and alkaline. Presumably, the precipitation of uranium is accelerated by concentration of organic material along channel floors . . .

According to Fisher and Schmincke (1984, p. 329) an oxygenated and well-flushed volcanic ash (i.e., glass) layer can leach high concentrations of uranium into solution, which can travel for great distances before precipitation occurs. The leaching of the radioactive elements and / or their daughters would also affect the radiometric dating of the sediments or materials contained within those sediments (Kulp, 1955, pp. 617-621; Gentry et al., 1976). In addition to radioactive elements and minerals, volcanic ash has also been identified as a source of a wide variety of trace elements including Y, Zr, Rb, Cr, Ni, Ag, Au, Mo, Sb, V, Li, Be, B, F, Sn, Cu, and Zn, along with many other elements and associated minerals (Fisher and Schmincke, 1984, p. 339; Galloway, 1978, p. 1669; Hildreth, 1979, pp. 56-57; Zielinski, Lindsey, and Rosholt, 1980, p. 144; Zielinski, 1982, pp. 194-195). The variety of minerals and elements found in combination with radioactive containing shales and clays should provide sufficient evidences to link the sedimentary unit to its volcanic origin.

The author suggests that where leaching and / or flushing has not occurred to a great degree, the volcaniclastic would retain the majority of its original radioactive composition, and associated elements and minerals and would simply alter in-situ into radioactive element containing clays and shales. This is not a new idea. Russell (1945, pp. 1483-1484) alluded to the possibility of a volcanic origin for radioactive marine shales, but discounted it due to insufficient evidence. Klein (1982, p. 87) suggested that uranium containing sandstone is "derived from a granitic or volcanic source containing uranium, and interbedded with mudstone." Grim (1968, p. 553) has stated that altered volcanic ash comprises a large quantity of the clays found in the Gulf Coast.

Thus it would appear that the Southeastern United States contains altered volcaniclastic deposits which are the source for radioactive elements. I acknowledge that other secondary causes can account for small accumulations of radioactive elements within the marine shales and clays. These secondary processes, however, cannot account for the massive accumulation of the radioactive elements in what are recognized as ore grade deposits.

Radioactive Shales and Clays: Examples From the Southeastern U.S.

As previously stated, the Southeastern United States contains many lithostratigraphic units which the author suggests are of volcanic origin. In this work two specific stratigraphic units (i.e., the Chattanooga Shale of Tennessee and the Hawthorne Group in west central Florida) are discussed to highlight evidence in support of their volcanic origin. Currently, uniformitarian scientists do not view these two stratigraphic units as being of volcanic ash origin. While some of these stratigraphic units extend outside of the Southeastern United States, it is beyond the scope of this paper to examine and correlate these units outside of what is proposed here. The primary reason is the potential variability caused by the mixing of what were originally volcanic sediments with other sedimentary, environmental facies. This potential variability would lead to an undefinable original source sediment. Other investigations must be performed to determine the original source(s) for sediments outside of the Southeastern United States.

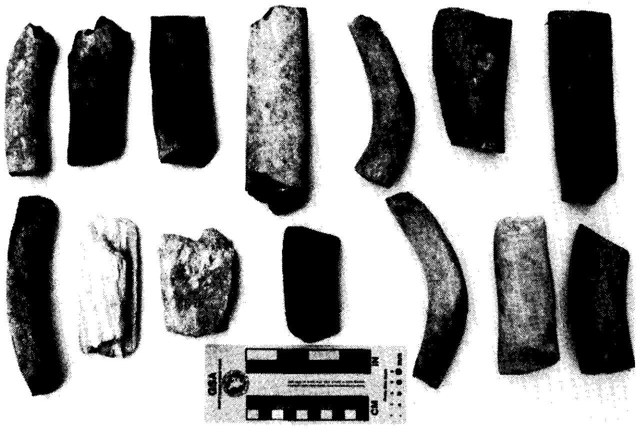

Figure 4. Radioactive fossilized "Sirenian rib bones" from the Bone Valley Member of the Hawthorn Group.

The stratigraphic units of specific interest for this article are the Devonian Chattanooga Shale found in Tennessee (Levorsen, 1967, p. 529; Press and Siever, 1974, p. 858; Upham, 1992, p. 47; Alexander 1953) and various clay units within the Miocene montmorillonitic Hawthorne Group (including the Bone Valley Member of the Peace Formation [Scott, 1988]) found in west central Florida (Cathcart, 1950; Calver, 1957; Miller and Sutcliffe, 1985; Campbell, 1986).

Volcanic Origin

I suggest that the Chattanooga Shale and various units within the Hawthorne Group clays represent two examples of what were originally radioactive volcanic ash deposits which have been altered and are no longer recognizable as such. Due to quick burial, both of these stratigraphic units still retain radioactive elements and have simply altered into the shales and clays we observe today.

Additional evidence for volcanic origin is suggested by the chert layers found immediately above the Chattanooga Shale (Fort Payne Chert) and in various layers throughout the Hawthorne Group. These chert layers are a logical consequence of the breakdown of silica rich material (i.e., volcanic ash) as it altered into various clay minerals. This alteration would release large quantities of silica into solution that would precipitate at lithologic contacts between strata and result in the formation of layers of silica-cemented sands or chert (Altschuler, Dwornik and Kramer, 1963, p. 151). If the original sediments were deposited as clays, then the release of large amounts of silica from those units would not be expected, and the chert layers should not exist. However, the existence of these silica-rich features suggests that there was an abundance of free silica derived from some source (e.g., volcanic ash) and that it precipitated from groundwater along a lithologic contact.

McKelvey and Nelson (1950, p. 43) describe the origin of uranium containing marine sediments as:

> . . . of syngenetic origin that is, it was deposited at the same time as the containing sediments. This is shown by the fact that thin uraniferous layers persist over areas of thousands of square miles with little if any change in lithology or uranium content and are interstratified with layers having markedly different composition, both as regards major and minor constituents. Moreover, the uranium-bearing rocks are as diverse in texture, permeability, and porosity as many of the non-uraniferous rocks with which they are interbedded.

A syngenetic origin would also fit for radioactive elements derived from a blanket of volcanic ash. The only difference would be one of time.

If sufficient flushing of these volcaniclastic units occurred, and geochemical conditions were such that the radioactive elements were liberated into solution, then the radioactive elements could move with the silica solution and/or groundwater. This is the suggested scenario for radioactivity found in the Florida Hawthorne Group. For example, the movement of ^{234}U with opal in solution has been suggested by Zielinski et al., (1980). However, if flushing of the original volcaniclastics did not occur in great measure, and this is what the author proposes for the Chattanooga Shale, then the radioactive elements would still largely remain within the altered clays and shales.

The Chattanooga Shale of Tennessee

I suggest that the Chattanooga Shale, as found in Tennessee, originated as a volcaniclastic deposit which mixed with organic debris. Work performed by Milici and Roen (1981, p. 2) has shown the Chattanooga Shale can be divided into four units based on color, which in turn is a function of organic content. However, their study did not report the levels of radioactivity found in each interval. Ettensohn, Fulton, and Kepferle (1979) documented the successful use of a scintillometer and gamma-ray logs in defining the radioactive profiles of organic-rich shales in Kentucky and Ohio, which are chronostratigraphic to the Tennessee Chattanooga Shale. Their work was performed in an attempt to correlate organic-rich shale sections across great distances. However, they did not suggest a possible source of the radioactive elements. Glover (1959) also used a scintillometer in his investigation of the variability in radioactivity and organic content of the Chattanooga Shale, as found in Alabama, Georgia, and Tennessee. Over time, and as a function of subsurface conditions, geochemical reactions between the original volcanic ash, organic material, and the connate groundwater would occur. The volcanic ash would alter to a clay and release silica and other soluble constituents. The addition of heat and pressure would subsequently alter the clay to a shale. If subsurface conditions did not provide a means of removing the radioactive elements from either the original ash or subsequent clay or shale via flushing and changes in the redox potential, then the radioactive elements would remain. This would result in the formation of a radioactive shale deposit, which this author suggests is representative of the Chattanooga Shale. The organic composition of the Chattanooga Shale is also believed to have adsorbed some of the leached radioactive elements (McKelvey and Nelson, 1950, p. 39; Swanson, 1960, p. 4).

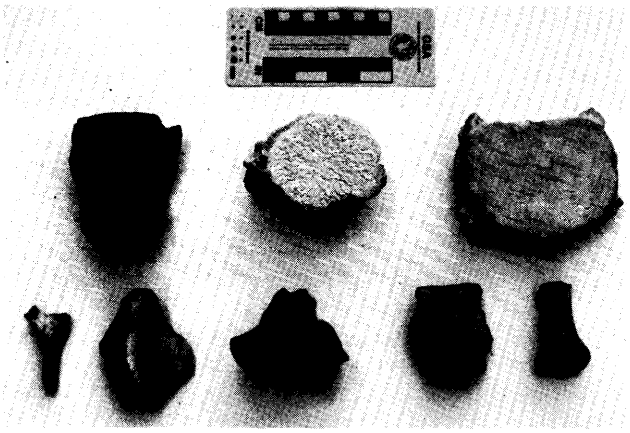

Figure 5. Radioactive fossilized miscellaneous vertebra (i.e., dolphin and whale) from the Bone Valley Member of the Hawthorn Group.

Today, the Chattanooga Shale is recognized as a lithified organic rich marine shale containing high concentrations of radioactive elements (Russell, 1945; McKelvey and Nelson, 1950; Beers and Goodman, 1944; Beers, 1945; Russell, 1945; Glover, 1959) (Figure 1). Levels of uranium found within the shale are sufficiently high to qualify the shale as a uranium ore (Upham, 1992, p. 47; Alexander, 1953). However, some variation in radioactivity is noted based on organic content. Studies have suggested that the richest organic layers (the “blackest” intervals) contain the highest concentrations of radioactivity (e.g., uranium, thorium and potassium).

Work performed by several investigators has also noted the unusually high concentrations of uranium and daughters, along with other metallic species, contained within thin seams of coal found within the Chattanooga Shale. These workers suggest that the uranium was added to the woody plant tissue following its deposition, but before it underwent coalification (Gentry et al., 1976, p. 316; Breger and Schopf, 1955, p. 292). This can best be explained by the alteration of a volcanic ash which leached radioactive elements into the formation pore water. As the pore water moved through these woody deposits, metals (radioactive and non-radioactive) precipitated due to the differences in geochemistry existing within these organic rich deposits. The deposits were later subjected to heat and pressure and formed into today’s radioactive shale and coal deposits.

The Hawthorn Group of West Central Florida

The clay units comprising the Hawthorn Group of west central Florida are also suggested as being clay units derived from volcaniclastic materials. In this case the original volcanic deposits did not mix with organic material (as did the Chattanooga Shale), but rather they mixed with the surrounding marine sediments. While the source of the volcanic ash remains unidentified, it is widely recognized that volcaniclastics can be transported via water currents over vast distances (e.g., Cas and Wright, 1987, p. 288; 1991, p. 372-374; Fisher and Schmincke, 1984, pp. 170-173). This would then not require a "local" volcanic ash source. The examination of trace metals and heavy minerals, along with any other "tracer" type elements or minerals, could possibly be used to identify the original source of those volcanic sediments.

Following the loss of transport energy and / or upon becoming water saturated, these volcaniclastics would sink to the seafloor and eventually alter into various clay minerals depending on redox conditions. With burial and alteration these volcanic ash layers would serve to release a variety of constituents into the groundwater (i.e., silica, radioactive and non-radioactive elements, and metals). Many of the overlying and underlying strata served as receptors of these leached materials.

Uranium-containing sands and clays, and land-pebble phosphate (i.e., carbonate fluorapatite or francolite) deposits associated with the Florida Hawthorne Group and the Bone Valley Member, respectively, have been described by scientists (Cathcart, 1950, 1955; Altschuler, Jaffe, and Cuttitta, 1955; Scott, 1988, 1990a; Campbell, 1986; Altschuler, Cathcart, and Young, 1994) (Figure 2). The phosphate pebble and gravel deposits contained within the Bone Valley Member are a recognized economic source of uranium (Campbell, 1986, pp. 8-12; Altschuler, Cathcart, and Young, 1994, pp. 52-55; Johnson, 1977, p. 31; Cathcart, 1985, p. 24). While I do not propose a volcanic origin for the phosphate deposits found within the Hawthorn Group, they were affected by the leaching of radioactive elements and other metals from adjacent volcaniclastics. Cathcart (1950, p. 150) speculated that the source of the uranium was from the phosphate and clays associated with it (Figure 3). However, recent research now questions the origin of metals (both radioactive and non-radioactive) from the phosphate deposits.

Swanson (1960, pp. 4-5) previously identified phosphate as a uranium receptor. Current research has revealed that apatite phosphate serves to absorb metals (including radioactive elements [Wright, Conca, Repetski and Clark, 1990, p. 310; Wright, Peurrung and Conca, 1994; Wright, et al., 1995]). Thus, the phosphate has absorbed and concentrated metals and radionuclides which have leached from the radioactive element and metal containing volcaniclastics. This research showing radioactive element and metal absorption by phosphate supports my s belief that the radioactive elements were derived from one or more volcanic ash layers (i.e., several units within the Hawthorne Group Clays), and not from the phosphate itself.

The Hawthorn Group of West Central Florida: The Bone Valley Member

It has also been suggested by Uniformitarians that uranium sandstone ore bodies form as a result of groundwater dissolution, transport, and precipitation of that element from source areas (e. g., mudstones, hydrothermal vents, vein deposits and **volcanic ash layers)** into the sand and sandstone lenses (Fischer, 1950, p. 1; Denson, Zeller and Stephens, 1955; Keller, 1979, pp. 428-430; Fisher and Schmincke, 1984, p. 329; Pettijohn, Potter and Siever, 1987, p. 463). The Bone Valley Member consists of phosphorite gravels and sands mixed with variable percentages of quartz sand and clay (Scott, 1985, p. 34), which vary in thickness from less than a foot to over 50 feet (15 meters) (Johnson, 1977, p. 30). The unit is believed to have become radioactive due to the replacement of calcium within apatite, by uranium via ion exchange (Altschuler, Cathcart, and Young, 1994, p. 54; Cathcart, 1985, p. 24; McKelvey and Nelson, 1950, p. 49). The Bone Valley Member also contains an interesting mix of both marine and terrestrial vertebrate bones (Scott, 1986,342; Scott, 1990b, pp. 330-331) which are radioactive due to their containing uranium, thorium, and radium. All of these radioactive elements are suggested by the author as having been derived and transported, via groundwater, from volcaniclastics which originally composed various units within the Hawthorne Group (Figure 4). This explanation better fits evidence which suggests that certain layers within the Bone Valley Member and the surrounding Hawthorne Group are more radioactive than others, and is based on the volcanic origin and subsequent migration of some of the radioactive isotopes from the adjacent Hawthorne Group into the sands and fossils deposits of the Bone Valley Member.

The Young-Earth Flood Model

The young-earth Flood model suggests that the global stratigraphic column was constructed rapidly and only within a few thousand years (mainly during the Flood). Physical evidence supporting this interpretation exists in the form of hundreds to thousands of vertical feet of volcaniclastic deposits which have altered to form many of the shales and clays we see today. This concept is radically different from the millions of years of uplift and erosion proposed by uniformitarians. In many cases, evidence for the rapid development of various sections of the stratigraphic record can be documented by their elemental or mineral constituents (e.g., radioactive elements, trace elements, and heavy minerals) which were part of the original volcaniclastic deposit. Additionally, as previously cited, many of the radioactive shale and clay layers are found as laterally continuous units which extend over thousands of square miles (e.g., Swanson, 1960, p. 7; Levorsen, 1967, p. 529; Frazier and Schwimmer, 1987, p. 237), and this clearly fits within a description of a volcanic ash fall. Kauffman (1988, p. 628) has found a direct connection between individual volcanic ash beds (i.e., bentonites) and organic carbon enrichment intervals in sedimentary units of the Western Interior Basin of North American. All of this information supports the catastrophic formation, via volcanic sources, for these radioactive sedimentary units.

The I am suggesting that the radioactive Chattanooga and Hawthorn Group volcaniclastics were added to the stratigraphic section at different periods of time within the Flood Event Timeframe (see Froede, 1995). It is beyond the scope of this paper to explain when and how these two stratigraphic units were deposited. However, the differences between the two units can clearly be seen by their variation in composition and the different tectonic settings in which both are found.

These specific stratigraphic sections clearly warrant additional study within the framework of the young-earth Flood model.

Differences in radioactivity for the various shale and clay layers is proposed as reflecting the amount of flushing that the volcanic deposits have experienced. As previously stated the "older" shales contain higher levels of radioactivity and would suggest rapid and deep burial with little water circulation occurring within them during or following the Flood. Many of the "younger" shales and clays have undergone greater flushing and were probably reworked following their deposition. These processes exposed the volcaniclastics to greater opportunity for leaching silica and metals (i.e., radioactive and non-radioactive), both during and after the Flood.

The fact that both the Chattanooga Shale of Tennessee and various units within the Hawthorne Group of Florida contain what are viewed as economic grades and quantities of uranium, together with other radioactive elements, can best be explained using the evidence supplied by their radioactive composition. Whether or not the Uniformitarians view these deposits in this manner has no bearing on the time frames suggested by their model. The young-earth catastrophist must suggest valid and defendable mechanisms for the rapid development of the stratigraphic column within the time frames required. The successful use of a scintillometer and gamma-ray logs (Ettensohn, Fulton, and Kepferle, 1979; Glover, 1959), in defining the radioactive profiles of organic-rich shales, and the gamma-ray logs across the radioactive aluminum phosphate zones (Alschuler, Cathcart, and Young, 1994, pp. 52-53), suggests a means of determining where the altered volcaniclastics can be located both in outcrop and in the subsurface (see also McKelvey and Nelson, 1950, pp. 50-52; Frazier and Schwimmer, 1987, p. 297; Miall, 1990, p. 75). This information could then be used to map the various shale and clay layers, which are of volcanic origin, in an attempt to better understand the depositional environment as we construct it within the framework of the young-earth Flood model. Volcanic ash layers can serve as excellent stratigraphic markers in determining chronostratigraphic equivalence (Miall, 1990, p. 96; Kauffman, 1988, p. 618). The use of volcanic ash layers to "date" specific events within the young-earth Flood model, however, must be based on more than paleontology (Froede, 1994b).

Conclusions

The uniformitarian model uses millions of years and some aspect of tectonism (i.e., uplifted areas) to explain the source(s) of sediments and the associated facies found in the vertical stratigraphic section of the Southeastern United States. A volcanic origin for many of these sediments becomes a serious possibility as one seeks to account for the high levels and patterns of radioactivity in many of the region's shales and clays. The volcanic ash origin for radioactive clays and shales better fits the young-earth Flood model. It allows for catastrophic depositional events to explain the radioactive shale and clay deposits, as well as the rapid construction of the overall vertical stratigraphic sequence.

The uniformitarian model for radioactive shale or clay is based on either long term exposure of the prelithified clays and shales to radioactive elements in seawater or the occurrence of radioactive heavy minerals derived from igneous intrusive sources and no longer found within the clay. These models fail to provide a satisfactory explanation for the occurrence of high concentrations found in only certain marine clays and shales. Additionally, these radioactive source theories fail to defend the uniformitarian model for a specific type of facies to explain its development.

The author suggests that the alteration of a volcanic ash better explains the occurrence of radioactivity found in the marine clays and shales around the earth, as well as the Chattanooga Shale of Tennessee and various units within the Florida Hawthorne Group.

Additional studies should be undertaken in an attempt to determine the original chemical composition of the volcanic ash (e.g., rhyolitic, andesitic or basaltic). Trace element analysis (e.g., Hildreth, 1979) along with heavy mineral analyses (e.g., Weaver, 1963) might also provide the location of volcanic sources and lend overall support to a volcanic origin for these radioactive deposits.

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References

CRSQ-Creation Research Society Quarterly.

Geol. Soc. Am. Bull.-Geological Society of America Bulletin.

Am. Assoc. Petro. Geol. Bull.-American Association of *Petroleum Geologists Bulletin.*

Adams, J. A. S. 1954. Uranium and thorium contents of volcanic rocks. In Faul, H. (editor). Nuclear geology. John Wiley. New York. pp. 89-98.

Alexander, F. M. 1953. The Chattanooga black shale, a possible future source of uranium. Tennessee Division of Geology Information Circular No. 1. Nashville.

Altschuler, Z. S., E. B. Jaffe and F. Cuttitta. 1955. The aluminum phosphate zone of the Bone Valley Formation, Florida, and its uranium deposits. In Page, L. R., H. E. Stocking, and H. B. Smith (compilers). Contributions to the geology of uranium and thorium by the United States Geological Survey and Atomic Energy Commission for the United Nations International Conference on peaceful uses of atomic energy, Geneva, Switzerland. U.S. Geological Survey Professional Paper No. 300. Washington, D.C. pp. 495-504.

______________ E. J. Dwornik and H. Kramer. 1963. Transformation of montmorillonite to kaolinite during weathering. *Science* 141: 148-152.

______________, J. B. Cathcart, and E. J. Young. 1994. Geology and geochemistry of the Bone Valley Formation and its phosphate deposits, west central Florida. Revised Field Trip Guidebook of the Miami Geological Society. Miami, FL.

Arthur, M. A. and B. B. Sageman. 1994. Marine black shales: Depositional mechanisms and environments of ancient deposits. *Annual Review of Earth and Planetary Science* 22:499-551.

Axelrod, D. I. 1981. Role of volcanism in climate and evolution. Special Paper No. 185. Geological Society of America. Boulder, CO.

Beers, R. F. 1945. Radioactivity and organic content of some paleozoic shales. *Am. Assoc. Petro. Geol. Bull.* 29:1-22.

——— and C. Goodman. 1944. Distribution of radioactivity in ancient sediments. *Geol. Soc. Am. Bull.* 55:1229-1254.

Bell, K. G., C. Goodman and W. L. Whitehead. 1940. Radioactivity of sedimentary rocks and associated petroleum. *Am. Assoc. Petro. Geol. Bull.* 24:1529-1547.

——— 1954. Uranium and thorium in sedimentary rocks. In Faul, H. (editor). Nuclear geology. John Wiley. New York. pp. 98-114.

Breger, I. A. and J. M. Schopf. 1955. Germanium and uranium in coalified wood from upper Devonian black shale. *Geochimica et Cosmochimica Acta* 7:287-293.

Byerly, G. R. 1991. Igneous activity. In Salvador, A. (editor). The Gulf of Mexico basin. The Geology of North America Volume J. The Geological Society of America. Boulder. pp. 91-108.

Calver, J. L. 1957. Mining and mineral resources. Florida Geological Survey Bulletin No. 39. Tallahassee.

Campbell, K. M. 1986. Geology of Polk County, Florida. Florida Geological Survey Open File Report No. 13. Tallahassee.

Carey, S. N. 1991. Transport and deposition of tephra by pyroclastic flows and surges. In Fisher, R. V. and G. A. Smith (editors). Sedimentation in volcanic settings. Society of Economic Paleontologists and Mineralogists. Society for Sedimentary Geology Special Publication No. 45. pp. 39-57.

Cas, R. A. F. and J. V. Wright. 1987. Volcanic successions. Modern and ancient. Chapman and Hall. New York.

——— 1991. Subaqueous pyroclastic flows and ignimbrites: An assessment. *Bulletin* of *Volcanology* 53:357-390.

Cathcart, J. B. 1950. Notes on the land-pebble phosphate deposits of Florida. In Snyder, F. G. (editor). Symposium on mineral resources of the southeastern United States: 1949 Proceedings. University of Tennessee Press. Knoxville. pp. 132-151.

———. 1955. Distribution and occurrence of uranium in the calcium phosphate zone of the land-pebble phosphate district of Florida. In Page, L. R., H. E. Stocking, and H. B. Smith (compilers). Contributions to the geology of uranium and thorium by the United States Geological Survey and Atomic Energy Commission for the United Nations International Conference on peaceful uses of atomic energy, Geneva, Switzerland. U.S. Geological Survey Professional Paper No. 300. Washington, D.C. pp. 489-494.

——— 1985. Economic geology of the land-pebble phosphate district of Florida and its southern extension. In Scott, T. M. and J. B. Cathcart (editors). Florida land-pebble phosphate district. Geological Society of America field trip guidebook: Southeastern Geological Society. Tallahassee. pp. 4-27.

Charnley H. 1989. Clay sedimentology. Springer-Verlag. New York.

Church. T. M. and M. Bernat. 1972. Thorium and uranium in marine barite. *Earth and Planetary Science Letters* 14:139-144.

Coleman, S. L., T. J. Crawford, and J. H. Medlin. 1986. Analyses of coal from northwest Georgia. Georgia Geological Survey Information Circular No. 76. Atlanta.

Daniels, F. 1954. Radioactivity, energy storage, and volcanism. In Faul, H. (editor). Nuclear geology. John Wiley. New York. pp. 188-194.

Denson, N. M., H. D. Zeller and J. G. Stephens. 1955. Water sampling as a guide in the search for uranium deposits and its use in evaluating widespread volcanic units as potential source beds for uranium. In Contributions to the geology of uranium and thorium by the United States Geological Survey and Atomic Energy Commission for the United Nations International Conference on peaceful uses of atomic energy, Geneva, Switzerland. U.S. Geological Survey Professional Paper No. 300. Washington, D.C. pp. 673-690.

Donn, W. L. and D. Ninkovich. 1980. Rate of Cenozoic explosive volcanism in the North Atlantic Ocean inferred from deep sea cores. *Journal of Geophysical Research* 95:5455-5460.

Eargle, D. H., K. A. Dickinson, and B. A. Davis. 1975. South Texas uranium deposits. *Am. Assoc. Petro. Geol. Bull.* 59:766-779.

Ettensohn, F. R., L. P. Fulton, and R. C. Kepferle. 1979. Use of scintillometer and gamma-ray logs for correlation and stratigraphy in homogeneous black shales: Summary. *Geol. Soc. Am. Bull.* 90:421-423.

Fischer, R. P. 1950. Uranium-bearing sandstone deposits of the Colorado Plateau. *Economic Geology* 45:1-11.

Fisher, R. V. and G. A. Smith. 1991. Volcanism, tectonics and sedimentation. In Fisher, R. V. and G. A. Smith (editors). Sedimentation in volcanic settings. Society of Economic Paleontologists and Mineralogists. Society for Sedimentary Geology Special Publication No. 45. Tulsa. pp. l-5.

——— and H.-U. Schmincke. 1984. Pyroclastic rocks. Springer-Verlag. New York.

Frazier, W. J. and D. R. Schwimmer. 1987. Regional stratigraphy of North America. Plenum Press. New York.

Froede, C. R., Jr. 1994a. Sequence stratigraphy and creation science. *CRSQ* 31:138-147.

———.1994b. Fossil wood of Big Bend National Park. *CRSQ* 30:187-189.

———. A review of heavy mineral occurrences on the Mississippi and Alabama Gulf Coast as evidence of volcanic sedimentation. Unpublished manuscript.

———. 1995. A proposal for a creationist geological timescale. *CRSQ* 32:90-94.

Galloway, W. E. 1978. Uranium mineralization in a coastal-plain fluvial aquifer system: Catahoula Formation, Texas. *Economic Geology* 73:1655-1676.

Gentry. R. V. Christie. D. H. Smith. J. F. Emery, S. A. Reynolds. R. Walker, S. S. Cristy, and P. A. Gentry. 1976. Radiohalos in coalified wood: New evidence relating to the time of uranium introduction and coalification. *Science* 194:315-318.

Glover, 1959. Stratigraphy and uranium content of the Chattanooga Shale in northwestern Alabama, northwestern Georgia, and eastern Tennessee. United States Geological Survey Bulletin 1087-E. Washington, D.C.

Grim. R. E. 1958. Concept of diagenesis in argillaceous sediments. *Am. Assoc. Petro. Geol. Bull.* 42:246-253.

———. 1968. Clay mineralogy. Second edition. McGraw-Hill. New York.

Hildreth, W. 1979. The Bishop Tuff: Evidence for the origin of compositional zonation in silicic magma chambers. In Chapin, C. E. and W. E. Elston (editors). Ash-flow tuffs. Geological Society of America Special Paper Number 180. Boulder, CO. pp. 43-75.

Huff. W. D.. S. M. Bergstrom and D. R. Kolata. 1992. Gigantic Ordovician volcanic ash-fall in North America and Europe: Biological, tectonomagmatic, and event-stratigraphic significance. Geology 20:875 878.

Johnson, W. 1977. Radioactivity and the Bone Valley Formation. In Environment of the central Florida phosphate district. Twenty-first field conference. Southeastern Geological Society Publication No. 19. Tallahassee. pp. 30-35.

Kauffman. E. G. 1988. Concepts and methods of high-resolution event stratigraphy. *Annual Review of Earth and Planetary Science Letters* 16:605-654.

Keller, E. A. 1979. Environmental geology. Second edition. Merrill Publishing. Columbus, OH.

Kennett, J. P. and R. C. Thunell. 1975. Global increase in Quaternary explosive volcanism. *Science* 197:497-503.

Klein, G. dev. 1982. Sandstone depositional models for exploration for fossil fuels. Third edition. International Human Resources Development Corporation. Boston.

Kulp, J. L. 1955. Isotopic dating and the geological time scale. In Poldervaart, A. (editor). Crust of the Earth. Geological Society of America Special Paper No. 62. New York. pp. 609-630.

Landes, K. K. 1976. Petroleum geology. Second edition. Robert E. Krieger Publishing. Huntington, NY.

Levorsen, A. I. 1967. Geology of petroleum. Second edition. W. H. Freeman. San Francisco.

Lockley, M. G. and A. Rice. 1990. Volcanism and fossil biotas. Special Paper No. 244. Geological Society of America. Boulder, CO.

McKelvey, V. E. and J. M. Nelson. 1950. Characteristics of marine uranium-bearing sedimentary rocks. *Economic Geology* 45:35-53.

Miall, A. D. 1990. Principles of sedimentary basin analysis. Springer-Verlag. New York.

Milici, R. C. and J. B. Roen. 1981. Stratigraphy of the Chattanooga Shale in the Newman Ridge and Clinch Mountain areas, Tennessee. Tennessee Division of Geology Report of Investigations No. 40. Nashville.

Miller, R. L. and H. Sutcliffe, Jr. 1985. Occurrence of natural radium 226 radioactivity in groundwater of Sarasota County, Florida. U.S. Geological Survey Water-Resources Investigations Report 84-4237. Washington, D.C.

Nations, D. and E. Stump. 1981. Geology of Arizona. Kendall/Hunt. Dubuque, IA.

Pettijohn, F. J. 1957. Sedimentary rocks. Second edition. Harper and Brothers. New York.

———, P. E. Potter, and R. Siever. 1987. Sand and sandstone. Second edition. Springer-Verlag. New York.

Press, F. and R. Siever. 1974. Earth. W. H. Freeman. San Francisco.

Rampino. M.R. 1991. Volcanism, climatic change, and the geological record. In Fisher, R. V. and G. A. Smith (editors). Sedimentation in volcanic settings. Society of Economic Paleontologists and Mineralogists. Society for Sedimentary Geology Special Publication No. 45. Tulsa. pp. 9-18.

Rice, A. 1990. The role of volcanism in K/T extinctions. In Lockley, M. G. and A. Rice (editors). Volcanism and fossil biotas. Geological Society of America Special Paper 244. Boulder, CO. pp. 39-56.

Ross, C. S. 1928. Altered Paleozoic volcanic materials and their recognition. *Am. Assoc. Petro. Geol. Bull.* 12:143-164.

________ 1955. Provenance of pyroclastic materials. *Geol. Soc. Am. Bull.* 66:427-434.

Russell, W. L. 1945. Relation of radioactivity, organic content, and sedimentation. *Am. Assoc. Petro. Geol Bull.* 29:1470-1494.

Sackett, W. M. and G. Cook. 1969. Uranium geochemistry of the Gulf of Mexico. *Transactions of the Gulf Coast Associations of Geological Societies* 19:233-238.

Scott, T. M. 1985. The lithostratigraphy of the central Florida phosphate district and its southern extension. In Scott, T. M. and J. B. Cathcart (editors). Florida land-pebble phosphate district. Geological Society of America field trip guidebook. Southeastern Geological Society. Tallahassee. pp. 28-37.

________ 1986. The Central Florida Phosphate District. In Neathery, T. L. (editor). Geological Society of America Centennail Field Guide Volume 6—Southeastern Section. Boulder. pp. 339-342.

________ 1988. The lithostratigraphy of the Hawthorne Group (Miocene) of Florida. Florida Geological Survey Bulletin No. 59. Tallahassee.

________. 1990a. A brief overview of Miocene lithostratigraphy-northern Florida and eastern Georgia. Florida Geological Survey Open File Report No. 31. Tallahassee.

________ 1990b. The lithostratigraphy of the Hawthorn Group of peninsular Florida. Florida Geological Survey Open File Report No. 36. Tallahassee.

Sharp, J. M., Jr., and J. K. Kyle. 1988. Ground-water processes in formation of ore deposits. In Back. W., J. S. Rosenshein. P. R. Seaber (editors). Hydrology. Geological Society of America. The Geology of North America Volume O-2. pp. 461-483.

Sheppard, C. W. 1944. Radioactivity and petroleum genesis. *Am. Assoc. Petro. Geol. Bull.* 28:924-952.

Sherborne, J. E., Jr., W. A. Buckovic, D. B. Dewitt, T. S. Hellinger, and S. J. Pavlak. 1979. Major uranium discovery in volcaniclastic sediments, Basin and Range Province, Yavapai County, Arizona. *Am. Assoc. Petro. Geol. Bull.* 63:621-646.

Smith, G. A. and D. R. Lowe. 1991. Lahars: volcano-hydrologic events and deposition in the debris flow-hyperconcentrated flow continum. In Fisher, R. V. and G. A. Smith (editors). Sedimentation in volcanic settings. Society of Economic Paleontologists and Mineralogists. Society for Sedimentary Geology Special Publication No. 45. Tulsa. pp. 59-70.

Swanson, V. E. 1960. Oil yield and uranium content of black shales. United States Geological Survey Professional Paper 356-A. Washington.

Sweeney, J. W. and S. R. Windham. 1979. Florida: The new uranium producer. Special Publication No. 22. Florida Bureau of Geology. Tallahassee.

Upham, G. A. 1992. Uranium. In Upham, G. A. (Coordinator). Tennessee minerals annual. Tennessee Division of Geology Bulletin 83. Nashville. p. 47.

Veeh, H. M., S. E. Calvert and N. B. Price. 1974. Accumulation of uranium in sediments and phosphorites on the South West African Shelf. *Marine Chemistry* 2:189-202.

Weaver, C. E. 1963. Interpretative value of heavy minerals from bentonites. *Journal* of *Sedimentary Petrology* 33:343-349.

Whitehead, W. L. 1954. Hydrocarbons formed by the effects of radioactivity and their role in the origin of petroleum. In Faul, H. (editor). Nuclear geology. John Wiley. New York. pp. 195-218.

Wignall, P. B. 1994. Black shales. Clarendon Press. Oxford.

Wood, W. W. and L. A. Fernandez. 1988. Volcanic rocks. In Back. W.. J. S. Rosenshein, P. R. Seaber (editors). Hydrology. Geological Society of America. The Geology of North America Volume O-2. pp. 353-365.

Wright, J., J. L. Conca, J. E. Repetski and J. Clarke. 1990. Microgeochemistry of some Lower Ordovician cordylodans from Jilin, China. *Courier Forschingsinstitut Senckenoerg* 118:307-331.

________ L. M. Peurrung, J. L. Conca. 1994. Phosphate stabilization of metal-contaminated soils. Fact Sheet. Richland, WA.

________, T. E. Moody, J. L. Conca, X. Chen, P. P. Didzerekis, and E. Wyse. 1995. In Situ immobilization of heavy metals in apatite mineral formulations. Strategic Environmental Research and Development Program. Milestone Three Report. Pacific Northwest Laboratory. Richland, WA.

Yen, T. F. and J. I. S. Tang. 1977. Chemical aspects of marine sediments. In Yen, T. F. (editor). Chemistry of marine sediments. Ann Arbor Science. Ann Arbor, MI. pp. 1-35.

Zielinski, R. A., D. A. Lindsey and J. N. Rosholt. 1980. The distribution and mobility of uranium in glassy and zeolitized tuff, Keg Mountain Area, Utah, U.S.A. *Chemical Geology* 29:139-162.

________. 1982. The mobility of uranium and other elements during alteration of rhyolite ash to montmorillonite: A case study in the Troublesome Formation, Colorado, U.S.A. *Chemical Geology* 35:185 204.

LETTERS TO THE EDITOR

A Reevaluation of Genesis 8:1-3

I find the discussion on the Flood in the Letters to the Editor of the March 1996 issue of the Quarterly to be very interesting. Two points of view on the timing of certain events are given with both sides having their reasons for holding their view. I am pleased that both sides agree that the Biblical record is the ultimate piece of evidence that must be satisfied. The physical record can sometimes be interpreted to favor both points of view. Froede (1996, p. 235) expressed this belief saying, "The young-earth creationist stratigraphic column must be reconstructed within the framework of the Biblical record."

Garner, et al. (1996, p. 233) state the problem, saying, "Oard's proposal is that essentially all dinosaur trackways and nesting sites were formed during the first 150 days of the Flood." Then they give their evidence that those sediments "should be assigned to the post-Flood era." I favor this later date on biblical grounds.

Let us review the first 150 days of the Flood.

The canopy, or whatever it was that held the water that fell to the earth for the Flood's first 40 days must have been equally distributed around the globe. If there had been no rain up to the Flood there must not have been any wind, only light breezes, during that time. Thus, when God "opened the windows of heaven," the rain must have fallen straight down everywhere around the globe. When the canopy was empty from day 40 onward, the sun caused evaporation. That water must have formed clouds, the first appearance of them, which eventually released the water as rain. Thus, the normal hydrological cycle that we know today was started. Winds probably started but not violent ones. The atmosphere must have been universally warm and the water that covered the earth was undoubtedly warm. Therefore, today's storm patterns did not materialize. These conditions continued until day 150 of the Flood, Genesis 7:24 "And the waters prevailed upon the earth a hundred and fifty days."

"Gabar," the Hebrew word translated prevailed, means to have strength, be strong, powerful, mighty and great. Those words indicate that the Flood was still building up in strength. The windows of heaven shut after 40 days but the fountains of the deep must have kept on pouring up water through day 150.

Then on day 151 God made several changes as are listed in Genesis 8:1-3.

1. The fountains of the deep were stopped.

The fountains of the deep had been broken on the day the Flood began. There had to be a reservoir of water in the crust that was under pressure since creation, but God broke open the crust to let the water come forth. It came forth for 150 days at which time God stopped the flow. I imagine this was accomplished by lava filling up the breaches in the crust.

2. The windows of heaven were stopped.

The windows of heaven were opened to start the Flood. Notice that while the fountains of the deep had to be broken to release the water, the windows of heaven were opened. The windows, whatever they were, were not broken. They were still in good shape. They were just opened so as to let their contents spill out. Forty days was all that was needed to empty the windows. From day 40 until day 150 they were in existence, but empty and open. Now on day 151 God closed them. The Hebrew word can also be rendered, shut up. The windows had been open for 150 days and now God shuts them. They are empty of water and are now closed.

Notice the difference between the fountains and the windows. The fountains had to be broken to release their water. When the breaks were plugged, the fountains no longer existed. The windows, however, were never broken. They were just opened but they remained in existence. There was no water in them and had not been any for 110 days. So the question now is, Why does God close them? Does He have a purpose for them? Is He going to refill them?

3. The rain from heaven was restrained.

What rain was this? The rain for the Flood had stopped 110 days earlier. The windows had been empty since then. So what rain was restrained?

As mentioned earlier, after the first 40 days the present hydrological cycle must have started. Thus for the next 110 days there must have been rain showers all around the globe. This then must be the rain that God restrained, restricted, withheld, shut up, kept back, all meanings of the Hebrew word.

4. God initiated a worldwide wind. I imagine this was a special rotating of the atmosphere around the whole earth.

Now, starting with day 151, we have a condition where water is not only evaporating all around the world, but the special wind must be drawing up water in sheets and evaporating it in the air. But God had restrained it from raining. So what is happening to it? It occurs to me that God must be putting that water in the windows which He had just shut up so they now could hold water again. In other words, He is rebuilding the canopy, or whatever the windows were.

The ramifications of a second canopy would be tremendous. The one thing that would happen is that it would moderate the weather around the globe. It would allow for life to grow in the polar regions as well as letting dinosaurs grow in various other areas. Thus the fossils now found in the frozen tundra, and in other areas were buried by some future upheaval.

It is obvious that the canopy is not in existence today. So it had to be emptied the second time which I will suggest was when the ice age started.

But first, we must decide if the Bible, which we claim is the deciding factor in building up the creationist model of earth history, really is telling us what I am suggesting that it does.

References

CRSQ — Creation Research Society Quarterly.

Froede, C. R., 1996. Late Cretaceous Epeiric Sea or Floodwater? (A reply to Garner, Robinson, Garton, and Tyler) *CRSQ* 32:234-237

Garner, et al. 1996. Comment on Polar Dinosaurs and the Genesis Flood. *CRSQ* 32:232-234

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Editorial Comment

In the early 1980's Mr. Peterson published the following articles relating to this subject:

Peterson, E. H. 1981. The necessity of the canopies. *Creation Research Society Quarterly* 17:201-4. 213.

____________. 1982. Reply to Raaflaub. *Creation Research Society Quarterly* 18:238-9.

____________ 1982. The atmosphere of Venus. *Creation Research Society Quarterly* 19:188-9.

Raaflaub, V. A. 1982. Comment on the necessity of the canopies. *Creation Research Society Quarterly* 18:237-8.

Sudden Appearance of the Immune System in Sharks

In the September 1996 issue of *Natural History* 105(9):40-47 there is an interesting article by Rosie Mestel entitled, "Sharks' Healing Powers." On pp. 40-41 it says:

> Sharks mark a great divide in the evolution of immunity: before them, not a trace of antibodies or other pivotal immune proteins; after them, all elements are in place.

John Marchalonis, who is head of the Microbiology and Immunology Department at the University of Arizona and a specialist in studies on the evolution of the immune system says that even though nobody prefers to believe that shark immune systems started in complete form, contrary evidence is difficult to locate.

So at the present time empirical evidence does not suggest an evolution of immune capacity leading to the sharks. In groups which evolutionists consider ancestral to these fish there are no traces of antibodies, T-cell receptors, MHC proteins, or RAG proteins which are found in sharks. The data, therefore appear to be very consistent with what would be predicted within a creationist model.

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Quote

Isaiah 66:1-2

This is what the Lord says: "Heaven is my throne, and the earth is my footstool. Where is the house you will build for me. Where will my resting place be? Has not my hand made all these things, and so they came into being?" declares the Lord.

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OBSERVATIONS OF FOSSIL MATERIAL AND CHARCOALIZED WOOD IN THE DAKOTA FORMATION IN COLORADO AND WYOMING

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Abstract

The plant and trace fossils at Dinosaur Ridge, Morrison, Colorado, are given further descriptions. Most of the plant fossils in this outcrop of the Dakota Formation are in the form of broken pieces of charcoal or as casts, which often record the wood grain. Charcoal fragments mixed within the sand are interpreted as being deposited under catastrophic conditions. Rocks containing the charcoal along bedding planes are interpreted as being deposited under conditions slow enough to allow buoyancy to separate the plant matter from the rock detritus.

Charcoal fragments were also present in the upper third of the Dakota Formation in the local region near Dinosaur Ridge, at Canon City, Montrose, and Fort Collins, Colorado, and at Newcastle, Wyoming. The charcoal appears to be catastrophically deposited in the region of Dinosaur Ridge and at Newcastle. Further observations and research may fit these widespread deposits into the middle to upper part of Flood strata.

Introduction

Holroyd (1992) described the fossil deposits in the Morrison and Dakota Formations at Dinosaur Ridge, a hogback ridge between Morrison and Golden, Colorado. Deposits of large dinosaurs bones were discovered there in 1877. The hogback strata are exposed by stream cuts in the area and by the road cuts of Interstate-70 and West Alameda Parkway. Interpretive signs, following a uniformitarian framework, are at both road cuts to aid self-guided tours. Holroyd (1992) provided a map of the area as his Figure 1.

The Friends of Dinosaur Ridge have been conducting, for the general public, guided tours of this same Alameda Parkway exposure once each month from April to October since 1990. Lately they have been offering guided tours for groups from public, private, and home schools. Most tours are given from the evolution / uniformitarian viewpoint but a few are presented from the creation / young-earth viewpoint.

MacKenzie (1972) provided an excellent description of part of the Alameda Parkway exposure. He included detailed diagrams and photographs of the upper 100 feet of the Dakota Formation there and interpreted the sequence as from tidal sand flat deposits. He estimated current directions from the orientations and asymmetries of ripples preserved in the rocks. Comparisons were made with modern formations elsewhere in the world. He indicated that the scarcity of muds in the sequence argues against the deposit being from a shoal water delta.

Holroyd (1992) argued that the mere presence of dinosaur fossils and footprints required rapid sedimentation rates. Otherwise the animals would have decayed or have been scavenged and unavailable for fossilization. Footprints are even more delicate and would suffer destruction with the next wave, tide, rain, or other disturbance. He described the plant fossil material as impressions of broken pieces of charcoal mixed with sand in a thick cross-bedded deposit. Nearly all plant material is fragmented beyond recognition.

Holroyd (1992) also examined the 1989 Sugarloaf Mountain forest fire site two years later. Charcoal and sand were still accumulating in the creek bed of Black Tiger Gulch. Small trenches were dug into numerous sandbars formed since the fire, in an attempt to locate a charcoal and sand mixture similar to that found at Dinosaur Ridge. All sand deposits examined were free from charcoal except scattered pieces on the surface. Density differences between the sand (quartz grain density 2.65) and plant matter (density 0.2 to 1.1, depending on waterlogging) indicate that in a normal depositional environment with abundant water and agitation the two materials would strongly segregate.

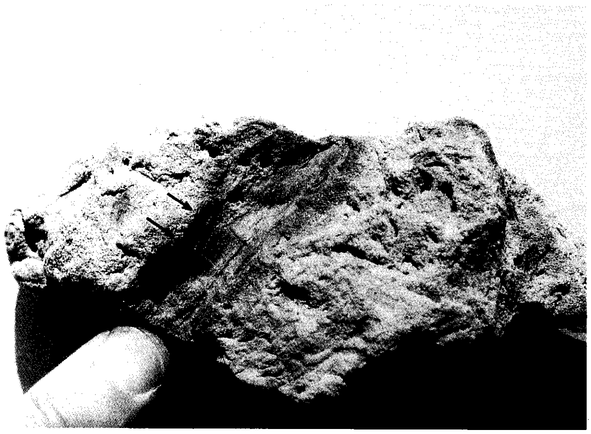

Figure 1. This is the only Dinosaur Ridge rock sample found by the author that appears to have an identifiable plant impression, that of an *Equisetum sp.* stem. The finger indicates the scale of the broad stem.

Holroyd previously suggested that the mixing of sand and charcoal at the Dinosaur Ridge plant fossil deposit indicated a catastrophic mud flow. Within a debris or mud flow there may be sufficient water to move the material but not enough to completely separate the various composing materials by buoyant forces. Such a flow deposit could occur in a matter of minutes. The lack of disruptive biological activity in this mud flow deposit in the form of large plant roots, animal burrows, or soil formation, limits the time for the formation of the entire deposit (tens of meters).

Combining the necessary deposition rates indicated by the charcoal mixture with those needed for burial of dinosaurs and preservation of their footprints, Holroyd (1992) suggested minimum rates of meters per year. Conventional geology assigns 50 million years for

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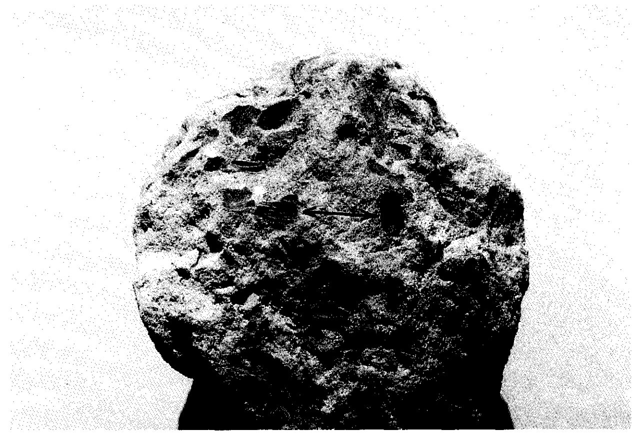

Figure 2. The dark hematite has served to preserve the wood grain orientation (shown by the arrow direction for the fragments to the left and right of the arrow). Some of the wood fragments found within this layer have sharp fractures perpendicular to the wood grain, indicating that they are likely to be derived from charcoalized wood and not green wood.

the 200 meters of rock in the combined Morrison and Dakota Formations at Dinosaur Ridge. Strict uniformitarianism would thus give an average net deposition rate of four micrometers per year. I made no attempt to fit all of the Dinosaur Ridge strata deposition into the single year of the Genesis Flood. Additional work is required to make this determination.

In an attempt to better understand the sand/charcoal mixing relationship, Holroyd (1996) examined a debris and mud flow from another forest fire site. I found that the mud had buoyant charcoal and plant matter mixed throughout two core samples. I found that the charcoal resided along bedding planes for deposits at the end of catastrophic flows and under normal, slow deposition conditions. I suggested that the two different occurrences of broken charcoal in the stratigraphic record can be used to partition a deposit into catastrophic (charcoal mixed within the matrix of sand and mud) and slow (charcoal along bedding planes) deposition.

Additional Dinosaur Ridge Observations

Identified Plant Debris— Holroyd (1992) described the plant material at Dinosaur Ridge as being broken beyond recognition. Subsequently, the author has found a stem impression, shown in Figure 1. Its surface features are somewhat indistinct and require rotating the specimen in directional illumination for highlighting the ridges. The cast's longitudinal striations and an apparent collar (between the arrows) match the patterns at joints of *Equisetum sp.*, a plant (horsetail, scouring rush) commonly found today along mid-latitude stream beds. This plant is also abundant in the fossil record. This is the only identifiable plant fragment I have found there to date.

Wood Grain— Additional samples of the plant fragments at Dinosaur Ridge have been found with excellent surface detail preserved. These are present where hematite concretion material has been deposited against the wood fragments. The fragment casts have a durable reddish brown surface. Casts without the hematite have a coarser, sandy surface with and without black colorations. The remarkable feature of the hematite coatings is that they preserve the wood grain direction of the fragment, making it visible to the naked eye. Some wood fragments, shown in Figure 2, have sharp fracture surfaces perpendicular to the wood grain. The dark patches to the right and left of the central double-headed arrow have the grain in the direction of that arrow. The separation of their nearest edges is 19 mm. Holroyd (1992) claimed that green wood broken to such small pieces should have frayed and irregular ends perpendicular to the grain. It can be easily verified at a campfire that charcoal pieces can have sharp fractures perpendicular to the grain or stem direction. Semi-rotten wood might have either end style, depending on the degree of decomposition. The presence of this wood grain detail and fracture pattern, together with the abundant carbon in the other casts, generally confirms that the plant material at Dinosaur-Ridge is mostly of broken charcoal. Other scientists, hearing this description, have pointed out that bacteria, worms, and insect larvae will not usually consume charcoal. giving it a longer opportunity for preservation than green or rotten plant matter.

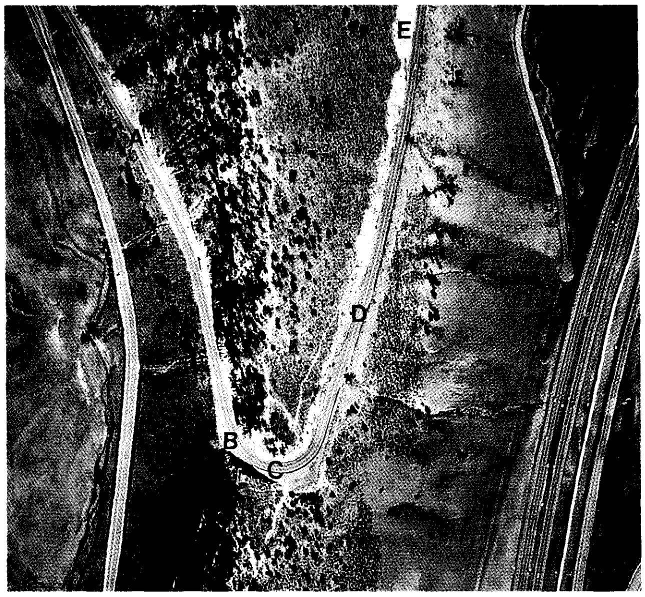

Figure 3. An aerial view of a portion of Dinosaur Ridge with north at the top. Dinosaur bones are to the right of the A. Invertebrate trace fossils are at B and E. Most of the plant fossils are at C and some at D. The 120 meter interval between C and D contains some symmetric long-crested ripples. A few dinosaur footprints are located between A and B and hundreds of prints are just north of E.

Fecal Pellets— On April 10, 1993, during a briefing tour for guides of Friends of Dinosaur Ridge, I found a rock at the cliff base near the middle of the left part of the panorama of Holroyd (1992, Figure 2, p. 8). It had fallen to the base of the channel sandstone deposit, to the lower left of the "C" in the aerial photograph of Figure 3. The rock, shown in Figure 4, is now stored at the Morrison Natural History Museum. It contained a detailed surface of grains resembling boiled rice along with some tubular structures (trace fossils) in adjacent layers. These grains have been interpreted as fecal pellets by several people who have examined them, including a scientist from the Denver Museum of Natural History who wanted the rock given to his museum. The pellets probably resulted from the excretions of

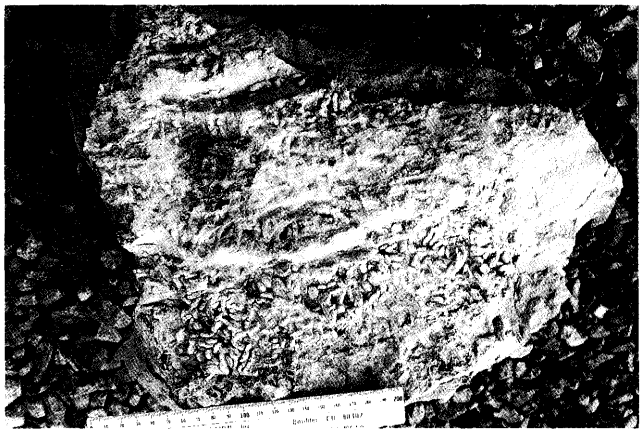

Figure 4. This rock surface is interpreted to represent fecal pellets and traces probably resulting from invertebrate animals (insects. worms, etc.). These animals may have fed on the organic matter in the Dinosaur Ridge deposits that was not deposited as charcoal. The ruler numbers the millimeters every centimeter.

small invertebrate animals feeding on the substrate debris after deposition but before its lithification. A passage of time would be indicated by the fecal pellets and the other trace fossils in the rock, but they provide no support for million-year interpretations of the Dakota Formation deposit. The use of trace fossils within the framework of the young-earth Flood model has been discussed in Cowart and Froede (1994).

Other Trace Fossils— At the west end of the road cut (extreme right in Holroyd (1992) Figure 2 and at the lower left of the "B" in Figure 3) the sandstone has an abundance of 2 to 5 mm diameter holes, interpreted as traces of invertebrate animals grazing on buried plant matter. The plant matter itself did not leave visible traces and was probably not charcoal. A few thin carbonaceous shales are between some sandstone strata and a few centimeters of volcanic ash are above the sequence.

Dakota layers higher in section and closer to the dinosaur footprints, at the "E" in Figure 3, have some excellent invertebrate traces, described in MacKenzie (1972) and interpreted as U-shaped vertical tubes *(Diplocraterion)* in sandstone. The original environment was interpreted as having been a marine shore with unconsolidated sand at the time of animal presence. Bioturbation of these original sands represents a limited passage of time easily compatible with a young earth time scale. Theoretically, an abundance of time for burrowing could homogenize the layer and could make the final burrows indistinct. Hence, the preservation of these U-shaped tubes suggests that the creatures were buried rapidly. That the layer is not homogenized suggests that the substrate was still in the early stage of being colonized.

Local Geographic Extents

The upper third of the Dakota Formation containing the fossil plant material (charcoal fragments) extends over a greater area at the Alameda Parkway site than previously indicated by Holroyd (1992). The charcoal fragment presence starts adjacent to the base of a 3.5 m thick channel sandstone (at "C" in Figure 3) at the Alameda Parkway road cut and extends to a thickness of about 11 m on the south side of the cut and about 16 m on the north side. The thickness could easily exceed 20 m when additional layers near the trail ramp (at "D" in Figure 3) are added. Near the top of this section are exposures of long-crested ripples, interpreted by MacKenzie (1972) as forming under subaqueous conditions. Crest separations are mostly about 5 cm, but some 10 cm spacings are present. Some crests have a slight asymmetry, indicating oscillating water with a minor current flow of less than 1 m s^{-1} (Collinson and Thompson, 1989, p. 68). They could have been formed in a variety of sheltered environments including in ponds, lakes, or lagoons. The Dakota Formation is suggested to represent the shore line deposit of a westward moving marine Zuni Sea (illustrated in Froede, 1995), extending across the interior of North America between the present Arctic Ocean and the Gulf of Mexico. Such an environment would be expected to have some locations conducive to the formation of ripples.

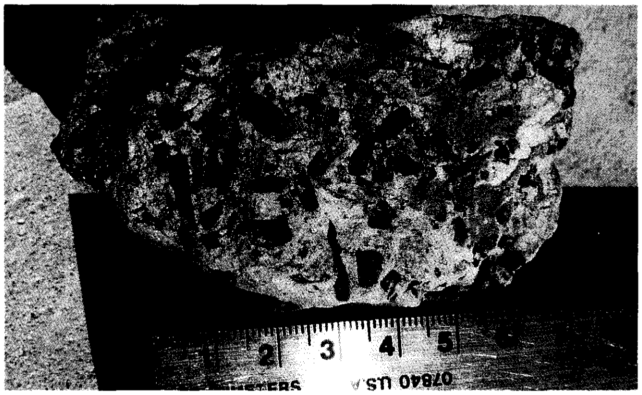

Figure 5. This rock from the Morrison Road cut through Dinosaur Ridge has an abundance of intact charcoal fragments, some showing wood grain direction. The scale numbers the centimeters of length.

It is important to know the extent of the deposits of charcoal fragments and sand within the Dakota Formation to see if it is local or widespread. The lateral extent, measured from the Alameda Parkway road cut, of the charcoal presence was checked at other road cuts and stream notches of the area. At Interstate-70, 3.1 km to the north, the charcoal fragments are present in vertically tilted cross-bedded strata. Black coloration in the cavities is lacking, but the shapes are similar to those at Alameda Parkway. The largest fragments are lowest in section (i.e., westward) and contain bark and branch impressions. The fragments generally become smaller moving up section (i.e., eastward) to the top of the formation. The deposits have the fragments along bedding planes and also mixed within the sandstone. Thick layers of carbonaceous shale and cross-bedded sandstone separate the numerous layers with the plant fragment casts. Some layers also exhibit ripple marks.

The rock sample shown in Figure 5 contains an abundance of charcoal fragments. It was found at the Morrison Road notch through the ridge, 2.6 km to the south. The amount of carbon is comparable to that shown in Holroyd (1992) Figure 5, but the fragment size is smaller. The wood grain direction is clear in many pieces of charcoal of this sample. The charcoal is mixed throughout the rock rather than confined to a bedding plane.

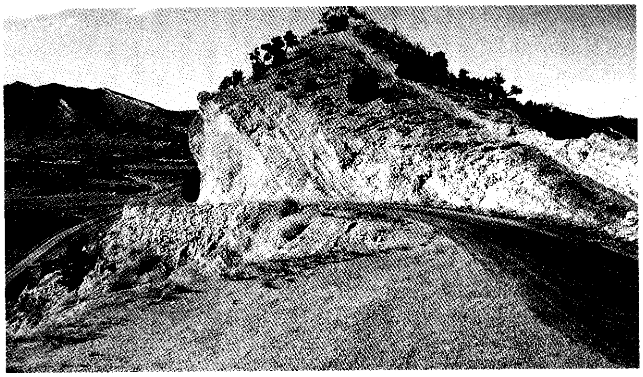

Figure 6. A view northward along the crest of the Dakota Hogback and Skyline Drive. The plant fossils were found along the left side just above the road.

The route 285 road cut, 4.8 km to the south, has been recently widened on the north side. The fresh decomposition of the shale is coating the rock surfaces with mud, obscuring the rock details. Some fallen rocks show a bold black and off-white pattern with centimeter-scale undulations. It appears that this route 285 exposure is a massive dump of powdered carbon and mud that combined to form carbonaceous shale. The undulations may have resulted from flowing, settling, and dewatering after initial deposition. The charcoal fragment angularity appears to be lacking in the rock fragments examined at the base of this new cliff.

At Belleview Avenue, 6.3 km to the south, only natural exposures are available for examination. A few layers of charcoal fragments were found. They were mostly along bedding planes and were seldomly within the bulk sandstone.

The evidence of the plant fragments, as casts and charcoal, therefore appears to extend at least 10 km along the Dakota Formation hogback near Dinosaur Ridge. There are significant variations in the style of the deposit among the exposures, ranging in particle size from bark and branch fragments to black powder, and from unblackened cavities to bulk carbon, with some cavities being lined with hematite. It therefore appears that the deposit is more complex and extends across an area broader than might be expected from a local creek bed or minor delta.

Remote Geographic Extents

Previous findings of the charcoal occurred about two-thirds of the way up through the Dakota Formation near Dinosaur Ridge. The same stratum was therefore examined at that level along Skyline Drive, on the hogback ridge on the west side of Canon City, Colorado, about 140 km south of Dinosaur Ridge. A much thinner (up to 20 cm) deposit of apparent charcoal and plant fragments (some large bark pieces) of the usual texture was found on the west side of the ridge north of where the road reaches the crest (at the road cut to the left side of Figure 6). The layer itself was a bedding plane in the context of the much thicker adjacent layers of sand, but the plant fragments were mixed with sand throughout that thin layer. Adjacent layers of sand had cross bedding and some coarse sand up to small pebble sizes.

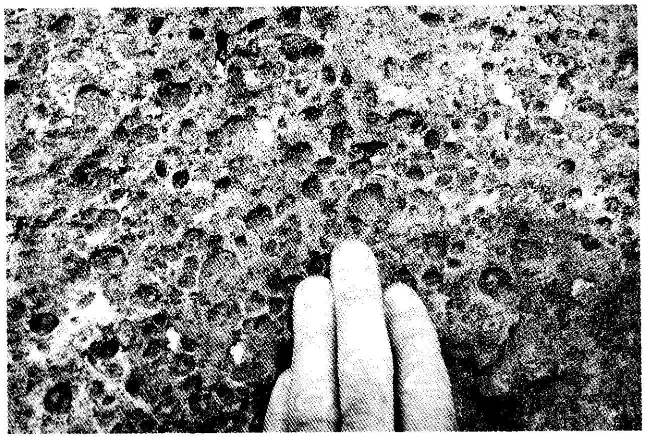

Figure 7. These hollow depressions in the Dakota Formation on the east side of the ridge at Canon City appear to be from balls of light-colored clay and not broken plant matter.

A layer with invertebrate trace fossils exists on the east side of the ridge. It is much thicker than at Dinosaur Ridge ("E" in Figure 3), but of a similar character. Also on the east side near the bottom of Skyline Drive are some layers with centimeter-sized *rounded* cavities in sandstone. At first glance they appear to have the plant fragment texture. Closer examination, as in Figure 7, shows that a few are filled with a pale tan clay. These impressions therefore seem to be the preservation of balls of rolled clay, indicative of a water current environment, and are not plant fragment impressions. This serves as a warning that care is needed in classifying the indistinct cavities in sandstone.

At Fort Collins, Colorado, about 90 km north of Dinosaur Ridge, the Dakota hogback forms the eastern boundary of Horsetooth Reservoir. At the southern end (Spring Canyon Dam) many black bedding plane layers of charcoal were found in light colored sandstone with relative crossbedding dips (with respect to the regionally strong tilt of the strata) of up to 40°. No examples of charcoal in bulk mixtures were found in this deposit of several meters thickness.

At Newcastle, Wyoming, about 460 km north of Dinosaur Ridge, and about a half kilometer north of the intersection of routes 16 and 85, the road cut has exposed the Dakota Formation dipping westward away from the Black Hills. The upper third of the Formation at this location has an abundance of crossbedded sandstone and some carbonaceous shale. Large charcoal pieces are present in bedding plane style and are also mixed throughout the sandstone. Weathering has dislodged some charcoal pieces and they have joined in the flow of erosional debris moving down the steep slope. A sample of 32 pieces, chosen for being large, had maximum dimensions of 1.5 ±.5 cm and a width perpendicular to that of 1.2 ±.5 cm. The third dimension was smallest. The pieces were of very light density, sometimes showed wood grain directions, and crushed to black powder in the same manner that modern charcoal can be crushed between one's fingers. There are also a few examples of hematite deposits about the plant fragments and some black-lined casts. This deposit therefore is similar to that found at Dinosaur Ridge.

Discussion and Conclusions

The mapping of the possible extent of the charcoal fragments in the upper third of the Dakota Formation should continue, especially into other states. Formation names and structure will change with region. Drilling cores can be examined for locations at which there are no outcrops of the Dakota formation. Hundreds of rock cores from the Dakota Formation are available at the USGS Core Research Center, Building 810, Denver Federal Center, for direct viewing and / or as core photographs. The porosity of the Dakota sandstones makes them of great economic value for petroleum and water reservoir rock. A future examination of the cores for charcoal mixed sediments appears to be a worthwhile undertaking. The study should note whether the charcoal is mixed into the sand and silt (catastrophic burial) or is found only along bedding planes (slow deposition) or both.

Holroyd (1992) has previously identified these same types of charcoal fragments from 300 km to the southwest near Montrose. The Canon City finding now puts them about 140 km to the south. The Newcastle deposit extends their range to about 460 km to the north. These charcoal deposits are found in state-sized dimensions. We need to determine if there might be continuity between the sites and if the phenomenon points to a catastrophic deposit of multi-state extent. This comprehensive investigation might eventually indicate the source region of the charcoal, which has yet to be determined, and the nature of the event that transported the sand and charcoal.

The deposits containing charcoal mixed within them are interpreted by this author as reflecting catastrophic deposits at Dinosaur Ridge. The bedded deposits of charcoal along the top surfaces of the flows reflect brief interludes before the next catastrophic flow. The lack of biological disturbances of the strata (animal burrows, tree roots, soil formation) emphasizes that little time lapse occurred between the catastrophic flows. Some physical processes generated ripple patterns within the upper part of this Dakota series.

This interpretation, however, has possible difficulties. What charcoal source is sufficient to provide debris to cover an area of at least two states? Where was the source located and how was that debris transported? Charcoal can come from fires ignited by lightning or volcanic activity, both of which were presumably abundant during the Flood year. Yet large fires with such an abundance of water seems questionable. Perhaps the wood was turned to charcoal while buried in hot volcanic ash, then eroded and redeposited elsewhere after being separated from the ash and its subsequent clays.

The forest fire site examples are in rugged mountains, not on flat plains. The Dakota depositional environment was supposed to be near a generally flat north-south marine shore line with sandy beaches. Higher terrain was thought to be in central Utah and western Wyoming. The topography of the depositional area should therefore be similar to the Gulf coast of Texas or the coasts of the southeastern Atlantic states from northern Florida to the Carolinas. We certainly need to examine those coastal areas to see what happens to charcoal debris. It would be expected to occur along bedding planes when buried. It would not be expected as mixed with the sand except by catastrophic actions, like the passage of a hurricane or tsunami. Furthermore, I expect burials of charcoal fragments there to be accompanied by a greater amount of coastal mud than is found at Dinosaur Ridge. I welcome the observations of readers who have access to such environments. Surely there have been forest fires in coastal regions that contribute sand and charcoal to sedimentary deposits towards the coasts. However, catastrophic flows should be unlikely.

Southern California, however, also has fires that contribute charcoal and sand to deposits. We read frequently of earth movements destroying houses after fires have denuded the higher terrain. I expect that deposits like those of Dinosaur Ridge and Storm King Mountain will be located there. The key is found in the elevation of the terrain. California and western Colorado have sufficient slopes to generate catastrophic flows with simply an abundance of rain. Gulf and Atlantic coastal areas have mostly gentle slopes by comparison that would strongly limit catastrophic events.

If this interpretation is true, then what happened at Dinosaur Ridge and Newcastle? The nearby topographic highs should not have been sufficient to generate the energy of catastrophic flows. The high ground was more than 500 km away. What kind of event is energetic enough in shallow coastal lowlands to produce catastrophic flows capable of mixing sand and charcoal? What kind of catastrophic event is gentle enough to avoid pulverizing all charcoal fragments?

Ordinarily, one would expect the same process to have operated at each of the charcoal deposition sites, but not necessarily at the same point in time. Yet in an energetic environment consistent with the last stages of a global Flood, rapid sea floor subduction (earthquakes and tsunamis), a hot ocean and cold cloudy atmosphere (torrential rains and strong winds), there could be many causes of catastrophic debris flows.

Charcoal is also found in other layers of the geologic record. The Dakota Formation discussed here is considered to be lower Cretaceous on the uniformitarian time scale. Upper Cretaceous charcoal from the Big Bend area of Texas was studied by Williams and Howe (1993) and Williams et al. (1993). Readers are encouraged to note charcoal fossils in regions familiar to them. The widespread production of charcoal is not necessarily an expectation from a direct reading of scriptures relating to the Flood. It should provide an interesting study topic to discover how the observed charcoal was produced and buried during a short time period with abundant water from rain and flooding. While volcanism was apparently associated with the Big Bend deposits, it is only a trace component of the Dakota Formation.

Acknowledgments

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References

Collinson, J. D., and D. B. Thompson, 1989. Sedimentary Structures, second edition. Chapman and Hall. London.

Cowart, Jack H., and Carl R. Froede, Jr., 1994. The use of trace fossils in refining depositional environments and their application to the creationist model. *Creation Research Society Quarterly* 31:117-124.

Froede, Carl R., Jr., 1995. Late Cretaceous epeiric sea or retreating floodwater? *Creation Research Society Quarterly* 32:13-16.

Holroyd, Edmond W., III, 1992. Comments on the fossils of Dinosaur Ridge. *Creation Research Society Quarterly* 29:6-13.

Holroyd, Edmond W., III, 1996. Confirmation from debris flow at a forest fire site. *Creation Research Society Quarterly* 33:141-151.

MacKenzie, David B., 1972. Tidal sand flat deposits in lower Cretaceous Dakota Group near Denver, Colorado. *The Mountain Geologist.* 9:269-277.

Williams, Emmett L., and George F. Howe, 1993. Fossil wood of Big Bend National Park, Brewster County, Texas: Part I-Geologic setting. *Creation Research Society Quarterly* 30:47-54.

Williams, Emmett L., George T. Matzko, George F. Howe, Richard R. White and William G. Stark, 1993. Fossil wood of Big Bend National Park, Brewster County, Texas: Part III-Chemical tests performed on wood. *Creation Research Society Quarterly* 30: 169-176.

LETTERS TO THE EDITOR

Tropical Storm Alberto, 1994: Some Catastrophic Geologic Consequences in Georgia

Introduction

Tropical storm Alberto moved northward out of the Gulf of Mexico and struck the Florida panhandle on July 3, 1994. The storm continued on its northeast trek and on the following day, it collided with a cold front moving from the northwest into southwestern Georgia. After meeting the cold front, the tropical storm retraced its path southward toward the Gulf. This combination of atmospheric conditions produced prolonged thunder showers with heavy precipitation over middle and southwestern Georgia.

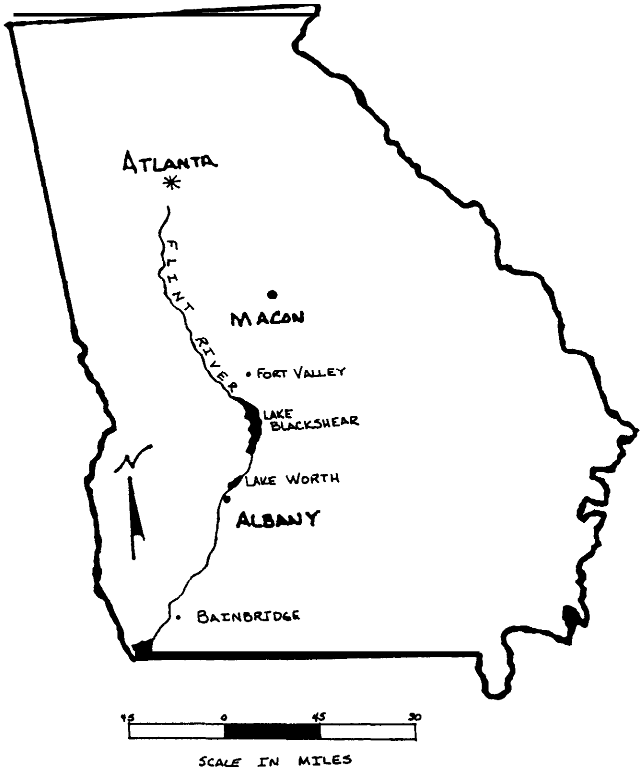

Figure 1. Map of the state of Georgia showing the course of the Flint River with its headwaters slightly south of Atlanta. The river flows southward through Albany which suffered major flood damage. Drawing by Thomas Bruce.

The maximum rainfall recorded in Georgia as a result of Alberto occurred during the period of July 3-7. The amount of precipitation varied from 3.00 inches in Atlanta to 27.06 inches in Americus.* Twenty-four inches of rain were recorded in Americus on July 6. Many regions of south central Georgia received 12-15 inches of rainfall in a 24-hour period. The Flint River (Figure 1) handled most of the runoff from the intense rainfall. Flooding that resulted from tropical storm Alberto was likely the worst natural disaster to occur in the history of the state.

Dam Breaching and Erosional Activity

Under such heavy rainfall during this tropical storm, soils and unconsolidated sediments were rapidly saturated, becoming unstable. Many farm ponds impounded behind earthen dams in the southwestern portion of the state were breached during the July 3-7 rainfall. Normally when a dam is breached, a "wall of water" is released causing extensive erosion and destruction below the dam. Local officials in Sumter County claimed that 15 people were killed in that county as a result of dam breaching episodes in July, 1994.

Two dams on the Flint River, one impounding Lake Blackshear and the other impounding Lake Worth above Albany, Georgia suffered damage during the flooding. These dams, constructed primarily for electrical power generation, are considered "run-of-the-river" dams with very little capacity to store large quantities of water above normal operating levels. At the Lake Blackshear dam site, earthen embankments are located on the north and south sides of the dam structure. The 3,000 foot-long northern embankment with a crest of approximately 11 feet above normal pool level was breached on July 9. The erosive power of the moving water initially developed a 500-foot wide breach which by the conclusion of the flood had expanded to about 800 feet with a depth of 10 to 20 feet. The Lake Worth dam was overtopped on July 7 (Figures 2a, b, c). This dam, rather than forming a 1,400 acre reservoir, was under the water of an 8,000 acre "lake" during the height of the flooding.

In the highway system of central and southwestern Georgia, approximately 1,600 bridges and culverts experienced washouts as a result of the surging flood waters (Figure 3). The authors will furnish more information on the locations of the various sites discussed in this letter to interested individuals.

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*Americus, in Sumter County, is 37 miles north of Albany, Georgia.

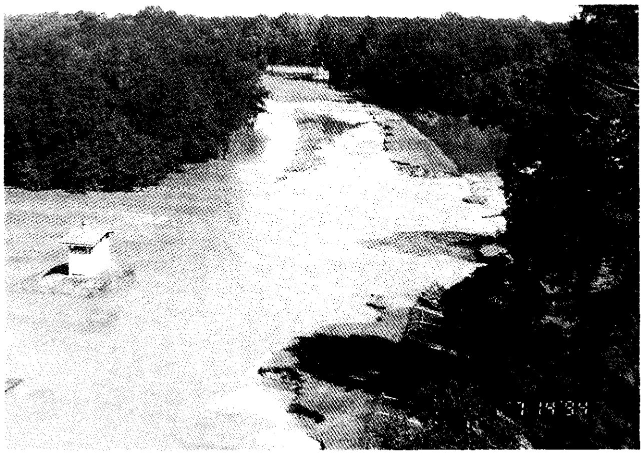
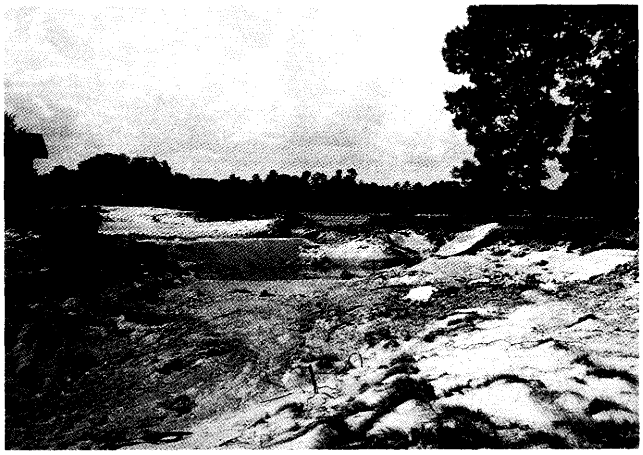
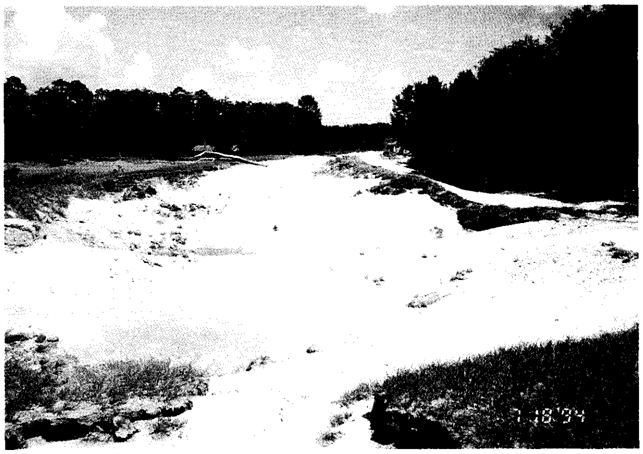


Figure 2 a. Raging flood water overtopping earthen dike at Lake Worth dam at Albany, Georgia. Photograph furnished by Jack Carson.



b. Erosional damage of earthen dike at Lake Worth dam. Photograph furnished by Jack Carson.



c. Sand deposited by flood waters along interior portion of earthen dike at Lake Worth dam. Photograph furnished by Jack Carson.

Sinkhole Formation

The city of Albany suffered the greatest damage during the flooding of the Flint River following tropical storm Alberto. This flooding triggered a collapse of 312 sinkholes in a mantled karst plain at Albany* (Hyatt and Jacobs, 1995, p. 53). It is thought that ". . . the sinkholes formed in association with raised water levels . . ." (p. 54) during the flood. Hyatt and Jacobs claimed that to the best of their knowledge ". . . this is the largest number of sinkholes ever reported to have formed in response to a single triggering event" (p. 67). Obviously, sinkholes pose potential hazards for land use. For instance, Hyatt and Jacobs photographed a house which had collapsed into a newly-developed sinkhole in Albany (p. 66). Another large sinkhole that formed during the flooding is shown in Figure 4.

Applications

Creationists have noted that more geologic work is accomplished during catastrophic events than during periods of "normal" geologic activity. Austin (1984, pp. 173-225) catalogued the damage wrought and the rapid sedimentation possible during water catastrophes. He claimed that:

> Floods are the world's most widespread, prevalent, and damaging type of natural disaster. In addition to the severe consequences of high rainfall, water can cause significant erosion or deposition from disturbances initiated by impulsive events such as storms, earthquakes, volcanic explosions, meteoritic impacts, and breaching of natural dams (p. 173).

Whitcomb and Morris (1963, pp. 259-261) discussed the destructive power of modern river floods. The havoc that occurred in Nelson County, Virginia in August, 1969 due to hurricane Camille was briefly described by Williams (1986, pp. 62-63) and Williams, Meyer and Wolfrom (1991, p. 94). The excessive rainfall in this county of steep mountains and narrow valleys quickly saturated the soil rendering it unstable causing landslides, mudslides and rock avalanches. Rock as well as unconsolidated material was scoured by raging flood water. The vast, rapid erosion at three midwestern sites during the 1993 floods in that region was graphically recorded by Wolfrom (1994, pp. 109-116). The recent catastrophic erosion of sediments in a Georgia canyon was presented in the Quarterly (Williams, 1995, pp. 29-43).

The breaching of natural dams shortly after the Flood or during periods of excessive precipitation, i.e., a post-Flood warm ice age, has been employed by creationists to explain some instances of rapid canyon formation. Such a mechanism was invoked by Austin (1994) when postulating the development of the Grand Canyon of the Colorado River within a young earth framework. Also see Brown (1989); Williams, Meyer and Wolfrom (1991; 1992a; 1992b); Oard (1993). Dam breaching, releasing impounded water, was used to suggest a means for the rapid post-Flood development of Pine Creek Gorge in Pennsylvania (Williams, Chaffin, Goette and Meyer, 1994) and Santa Elena Canyon in Texas (Williams and Howe, 1996). The effects on Rocky Mountain National Park as a result of the failure of Lawn Lake Dam in July, 1982 were noted by Williams (1993). Rapid deposition of sediments during a hurricane and a rainstorm was briefly examined (Williams, 1994, pp. 91-92).

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*Albany is on the Dougherty Plain which is underlain by Ocala Limestone.

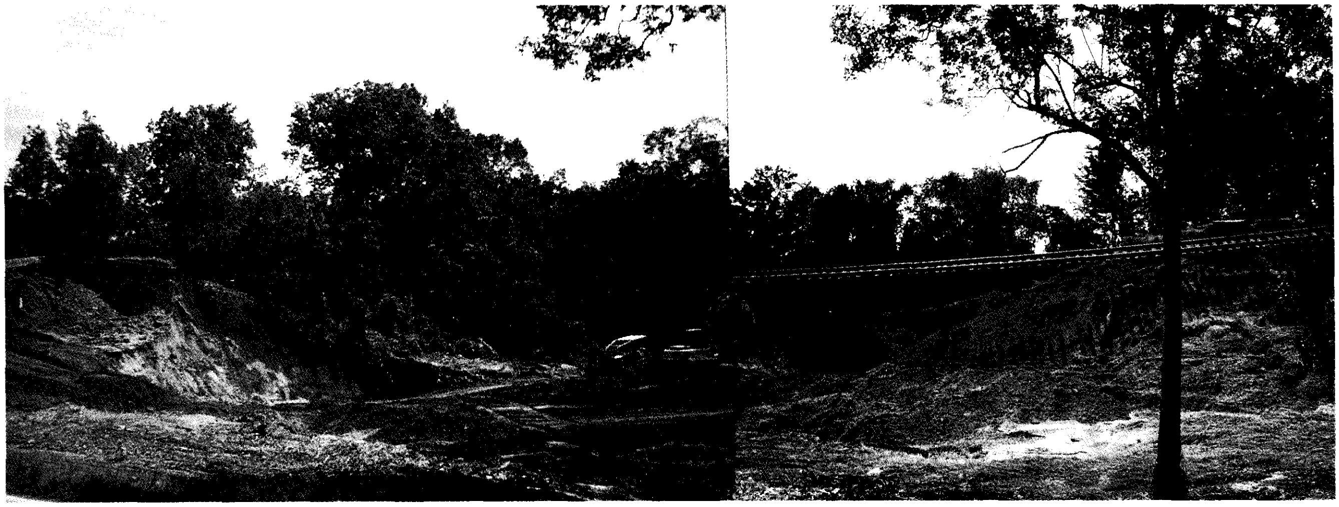

Figure 3. A railroad embankment parallel to state route 49 near Fort Valley, Georgia experienced complete washout during the flooding in July 1994. The photographs were taken nine days after the flood event. Replacement of the embankment had begun. Over one million cubic yards of soil and sediment were removed from this embankment by rapidly moving water in an intermittent stream. When we revisited the site in December, 1995, no water was flowing in the stream. Photographs by Thomas Bruce.

Conclusions

Rapid erosion, subsequent sediment deposition and formation of hundreds of sinkholes that occurred during the catastrophic rainfall and flooding in Georgia in 1994 caused by tropical storm Alberto reinforce the emphasis placed on such events by creationists as the major force in the shaping of the earth's surface. Gradual processes are not as important as the forces unleashed during catastrophic events in causing major erosion and sedimentation. Some creationist writings on catastrophism in geology have been cited to illustrate that the excessive rainfall and subsequent flooding in Georgia during 1994 offer verification of creationist postulations concerning the importance of catastrophic processes in earth history.

Acknowledgments

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References

CRSQ—Creation Research Society Quarterly.

Austin, S. A. 1984. Catastrophes in earth history: A source book of geologic evidence, speculation and theory. ICR Technical Monograph 13. Institute for Creation Research. El Cajon, CA.

——— (Editor). 1994. Grand Canyon: Monument to catastrophe. Institute for Creation Research. Santee, CA.

Brown, Jr., W. T. 1989. "In the beginning . . ." (Fifth Edition). Center for Scientific Creation. Phoenix, AZ.

Hyatt, J. A. and P. M. Jacobs. 1995. Recent sinkhole development on the Dougherty Plain at Albany, GA in Carter, B. D. Editor. Paleogene carbonate facies and paleogeography of the Dougherty Plain region. 30th annual field trip, Georgia Geological Society. pp. 53-70.

Oard, M. J. 1993. Comments on the breached dam theory for the formation of the Grand Canyon. *CRSQ* 30:39-46.

Whitcomb, Jr., J. C. and H. M. Morris. 1963. The Genesis Flood: The biblical record and its scientific implications. Presbyterian and Reformed. Philadelphia.

Williams, E. L. 1986. Local flood damage. *CRSQ* 23:62-63.

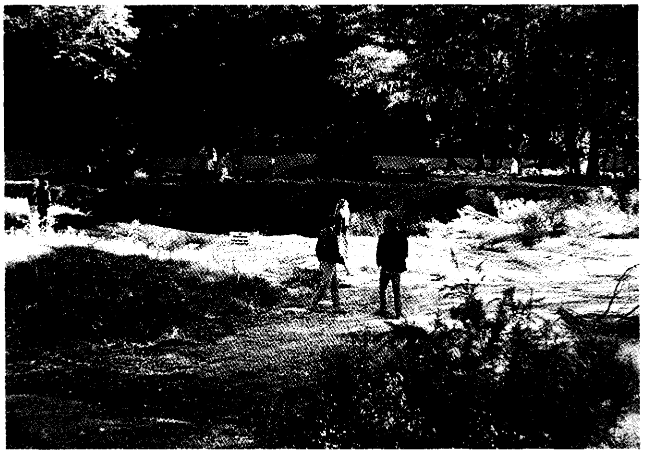

Figure 4. A large, elongated sinkhole located approximately 30 meters west of Kinchafoonee Creek at the northern edge of Albany, Georgia that developed during the flooding of July, 1994. Sinkhole dimensions are length = 44m, width = 21m, depth approximately = 3.1m, volume approximately = 905m3. Photograph by Emmett Williams.

——— 1993. Catastrophism—dam breaching in the Rocky Mountains. *CRSQ* 30:86-89.

——— 1994. Rapid deposition of thin laminae sediments. *CRSQ* 31:91-92.

——— 1995. Providence Canyon, Stewart County, Georgia—evidence of recent rapid erosion. *CRSQ* 32:29-43.

——— and G. F. Howe, 1996. The formation of Santa Elena Canyon, Big Bend National Park: Origin speculations. *CRSQ* 33: — .

——— E. F. Chaffin, R. L. Goette and J. R. Meyer. 1994. Pine Creek Gorge. the Grand Canyon of Pennsylvania: An introductory creation study. *CRSQ* 31:44-59.

———, J. R. Meyer and G. W. Wolfrom. 1991. Erosion of the Grand Canyon of the Colorado River: Part I—review of antecedent river hypothesis and the postulation of large quantities of rapidly flowing water as the primary agent of erosion. *CRSQ* 28:92-98.

——— 1992a. Erosion of the Grand Canyon of the Colorado River: Part II-review of river capture, piping and ancestral river hypotheses and the possible formation of vast lakes. *CRSQ* 28:138-145.

——— 1992b. Erosion of the Grand Canyon of the Colorado River: Part III—review of the possible formation of basins and lakes on Colorado Plateau and different climatic conditions in the past. *CRSQ* 29:18-24.

Wolfrom, G. W. 1994. The 1993 Midwest floods and rapid canyon formation. *CRSQ* 31:109-116.

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Rapid Delta Formation — Coastal Louisiana

Introduction

The Atchafalaya River (Figure 1) carries considerable suspended load as it flows into Atchafalaya Bay (Figure 2). Two deltas are rapidly forming in the bay because of deposition of this suspended material from the Atchafalaya River flow (Figure 3). Several hundred years ago some of the Mississippi River flow, which drains approximately 1,240,000 square miles [3,210,000 km^2] was captured by the Atchafalaya River (Roberts, 1995, p. 2). Also the Red River flowing into the Atchafalaya (Figure 1) drains 87,850 square miles [228,000 km^2] of area. As Roberts (p. 4) notes:

> . . . the Atchafalaya presently averages about 50 percent of the discharge and over 60 percent of the suspended load of the Mississippi. . . . Thus, the Atchafalaya River has substantial land building capacity.

History of River Capture — Natural Circumstances and Man's Activities

The Atchafalaya River has been recognized as a distributary of the Mississippi River since 1542 (Shlemon, 1975, p. 212; Roberts, 1995, p. 3). However the discharge from the main stream (Mississippi) to the distributary (Atchafalaya) was periodic and limited in volume. After clearing log jams in 1839 and continual dredging for a navigational channel, the flow from the mainstream into this distributary increased.

The Atchafalaya River only flows 141 miles [227 km] to the Gulf from its juncture with the Old River segment (Figure 1) of the Mississippi River (Shlemon, 1975, p. 212). Whereas the Mississippi winds 301 miles [485 km] to Head of Passes (Figure 1) from the juncture and even further to the Gulf. This obvious difference in gradient was ideally suited for the complete abandonment of the modern channel and the eventual diversion of the entire flow of the Mississippi into and down the Atchafalaya. Shlemon (1975, p. 212) claims:

> By 1940 the diversion of the Mississippi water was sufficient for natural maintenance of a connecting channel, and the eventual capture of the Mississippi by the Atchafalaya River seemed apparent.

If the Atchafalaya had captured the complete flow of the Mississippi River, the ports of Baton Rouge and New Orleans would have been in serious trouble. However in 1963, the capture of the Mississippi by the Atchafalaya was terminated by the building of a control structure at the juncture of the two rivers (Roberts, 1995, pp. 3-4). Since 1963, the Atchafalaya River discharge as been regulated to 30 percent of the combined Mississippi River and Red River 1950 flow regime (Roberts, Adams and Cunningham, 1980, p. 266).

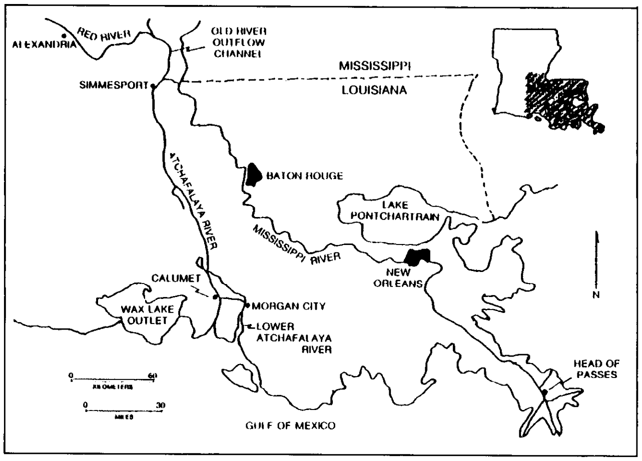

Figure 1. Location of the Atchafalaya and Mississippi Rivers in southeastern Louisiana. The shaded area of the state map has been enlarged to show the region of interest (after Roberts, 1995, p. 2).

The average discharge of the Atchafalaya River at Simmesport is 226,760 cubic feet per second [6421 m^3/s] with an average annual peak flow* of 428,000 cubic feet per second [12100 m^3/s] (Roberts, 1995, p. 4). Seventy percent of this flow passes through the lower Atchafalaya River to eastern Atchafalaya Bay. The remainder passes through the 13 mile [20.8 km] shortcut (New Pass), created by the Wax Lake Outlet, to the western part of the bay.

Atchafalaya Bay

Atchafalaya Bay is flanked by low-lying marshes only 3.3 feet [1 m] or less above sea level (Shlemon, 1975, p. 211). The water of the bay is shallow, typically less than 6.6 feet [2 m] deep. About 10 miles [16 km] seaward from the mouth of the Atchafalaya River, the Point au Fer shell reef (Figure 2) forms a natural barrier to the bay. The main navigational channel crosses the bay extending the mouth of the river through the shell reef. Dredging is done periodically to maintain this channel. At the Wax Lake outlet, created in 1942, a four mile [6.4 km] channel trends southward from New Pass to an inner shoal reef area. The bay is dotted by many offshore oil wells, platforms and pipelines.

Rapid Delta Growth (Progradation)

As noted, there is considerable flow down the Atchafalaya River. The annual sediment load of the river at Simmesport from 1952 to 1989 has been approximated as 88,223,000 tons (Roberts, 1995, p. 7). Once the sediment enters Atchafalaya Bay, there is considerable potential for delta formation. However as Roberts (1995, p. 2) noted: "There was little awareness of the delta building event until a few lobes from the emerging delta became marginally subaerial in 1972 . . . and gained full exposure in 1973 . . ."

The Atchafalaya and Wax Lake deltas (Figure 3) now have a combined area of 22 square miles [57 km^2]

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*High flows generally occur between January and June.

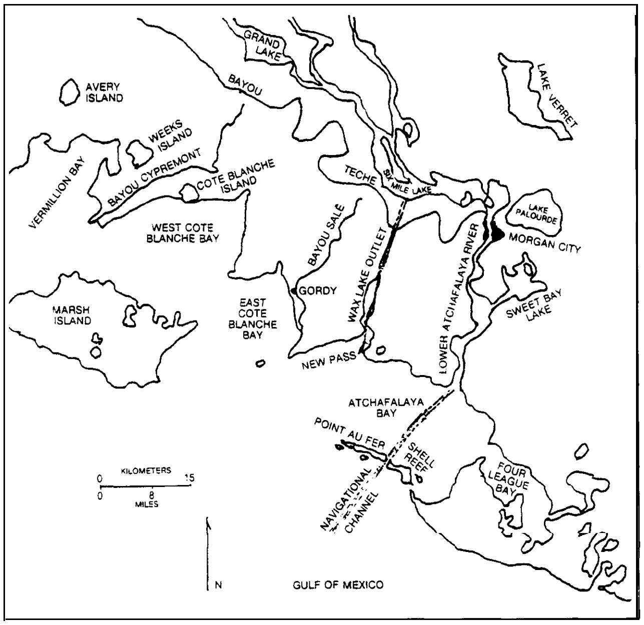


Figure 2. Atchafalaya Bay in southeastern Louisiana (after Shlemon, 1975, p. 210).

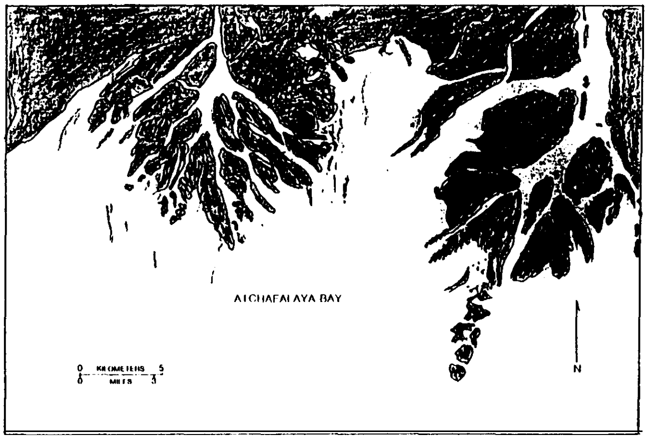


Figure 3. Drawing from an aerial photograph of the Atchafalaya and Wax Lake delta lobes (1990). The Atchafalaya Delta is on the right, whereas the Wax Lake Delta is on the left.

above tide datum and are less than 12 feet [3.7 m] thick (Roberts, 1995, p. 1). The growth of the deltas is illustrated in Figures 4-6. The difference in the rate of growth of the two deltas is due to man's activities. The Atchafalaya Delta growth is slower because of continual dredging to maintain a deep channel. The dredging of Wax Lake Outlet ceased in the early 1980's so that delta progradation has proceeded somewhat naturally. It is predicted that if the present growth rates are sustained, the Wax Lake Delta should cover an area of 21.6 square miles [55.9 km^2] or 13,840 acres (a growth rate of 650 acres per year) by the year 2000 (Roberts, 1995, pp. 8-9).

Figures 7-10 record the appearance of one of the recently-emerged delta lobes in Atchafalaya Bay. Walking on the sediments in the lobe is very unsettling since

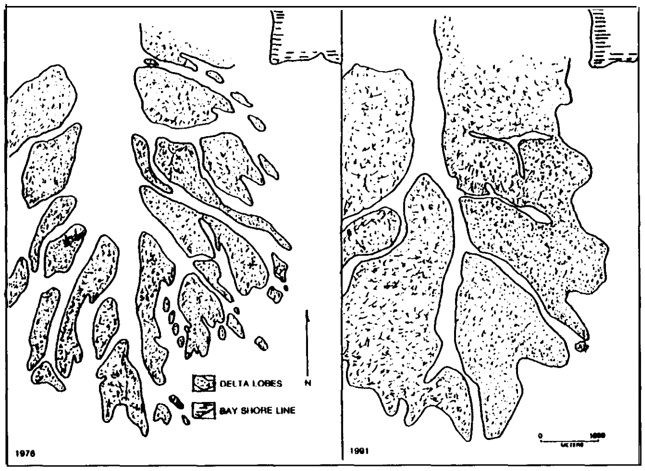


Figure 4. Subaerial growth of Atchafalaya delta lobes from 1976 to 1991 (after Roberts, 1995, p. 14).

they are not compacted to any great extent (Figure 10). If one has walked on soft mud, swampy ground or deep, wet sand, it is similar to walking on a lobe that has recently become subaerial. If several people walk across the same "path," the repeated travel causes treacherous footing and the last travelers across the same trace can sink downward in the soft sediments up to their knees!

Interested readers who wish to explore more details on delta formation in the Mississippi River delta complex are urged to consult the following material along with the references cited in the text: Coleman, n.d.; Kolb and Van Lopik, 1966; Coleman and Pryor, 1982; Swanson, 1983; van Heerden, Wells and Roberts, 1983; van Heerden and Roberts, 1988.

Applications for a Different Model

The rapid build-up and formation of deltas in Atchafalaya Bay offer creationists an opportunity to observe the actual process as it unfolds. Uniformitarian geologists often interpret many sections of a rock formation as being components of ancient deltas. Probably one of the most well-known instances of a postulated delta is the Devonian Catskill Delta in the northeastern United States. Shlemon (1975, p. 209) suggests that the growth of the Atchafalaya and Wax Lake deltas: ". . . may illustrate early-phase deltaic formation in an actively subsiding area, represented well in ancient rocks, for example, by the Devonian Catskill Delta . . . , assuming that the present is the key to the past.

Creationists have generally been suspicious of delta formation from "prehistoric" rivers flowing into ancient oceans as an explanation for massive formations in the geologic record. Rivers simply do not carry sufficient load to form the gigantic deltas found in sedimentary rock. See Coffin (1983, pp. 112-113). Also Steve Austin (1994, pp. 28-39) refutes the concept of a delta when discussing the origin of the Supai Group in the Grand Canyon region. Creationists usually argue that only a

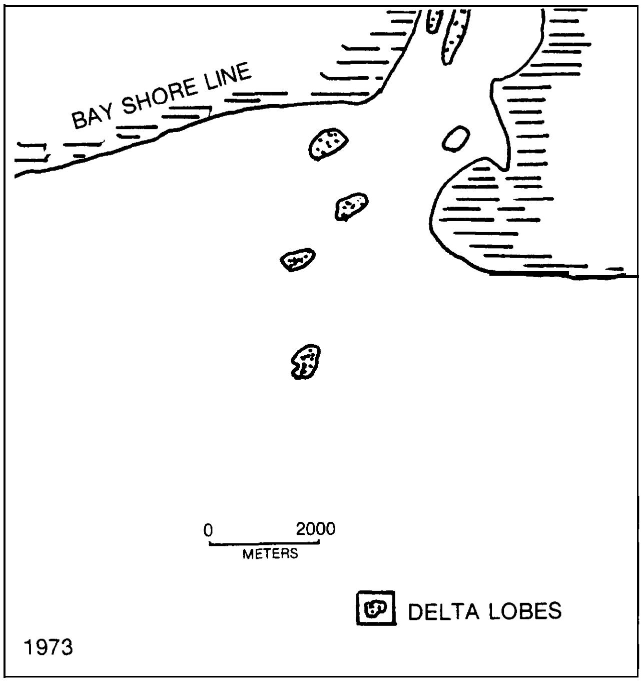
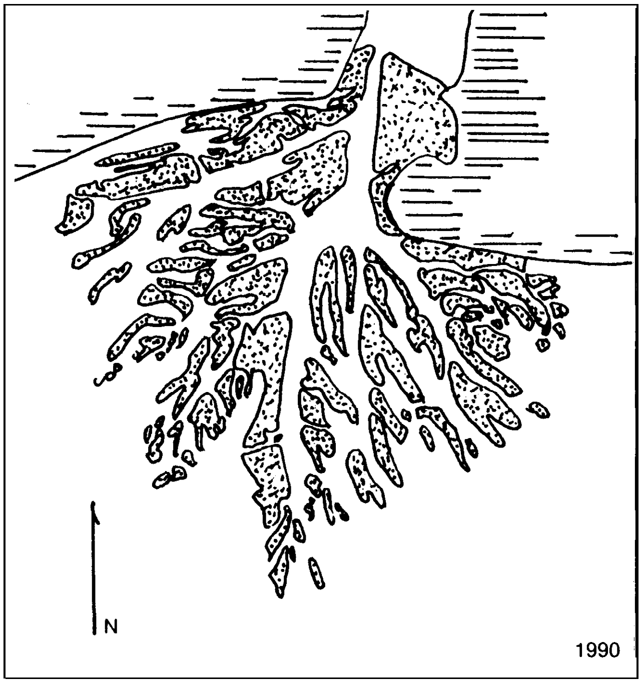


Figure 5. Subaerial growth of the Wax Lake delta lobes from 1973 to 1990 (after Roberts, 1995, p. 17).



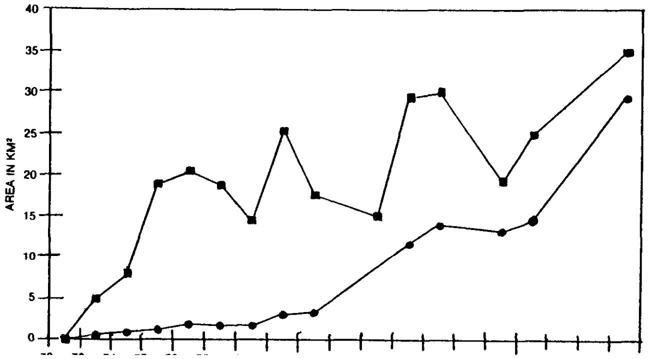


Figure 6. Subaerial delta growth curves as area above mean low tide in Atchafalaya Bay. Note that there have been five different years when the Atchafalaya Delta has experienced a subaerial land loss. The dredged navigational channel is very efficient as a conduit for carrying sediment from the river mouth into the Gulf of Mexico. During low flood years, insufficient sediment is deposited in the delta system to balance any land loss. Water setup/setdown and wind/wave action caused by the passage of winter cold fronts result in substantial erosion reducing the subaerial land area on the Atchafalaya Delta during those years (Roberts, 1995, pp. 10-11).

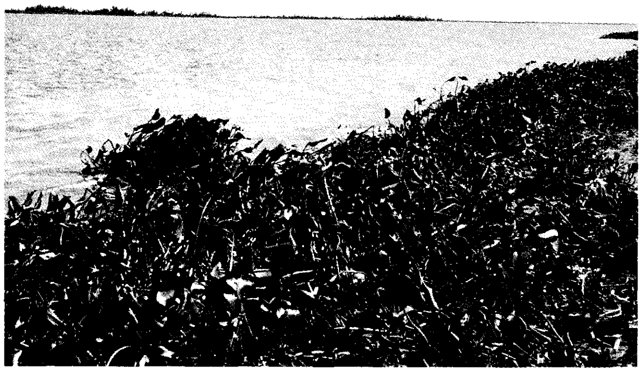


Figure 7. View along the edge of a delta lobe looking southeast. The plants are water hyacinths (genus *Hyacinthus)* [1995].

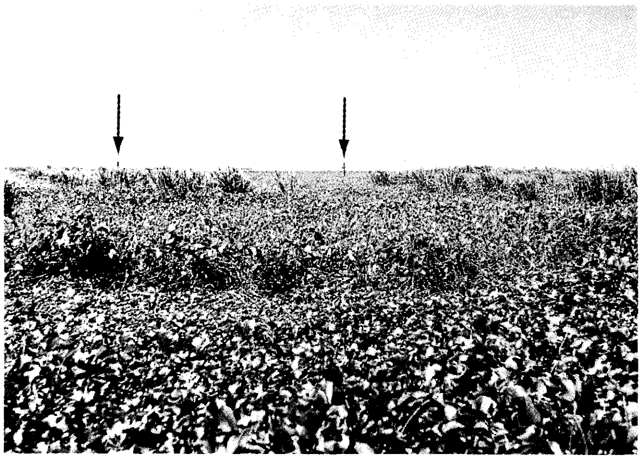


Figure 8. View into the interior of a delta lobe looking west. The two posts, indicated by arrows, rising above the horizon, likely were channel markers before they were surrounded by sediment [1995].

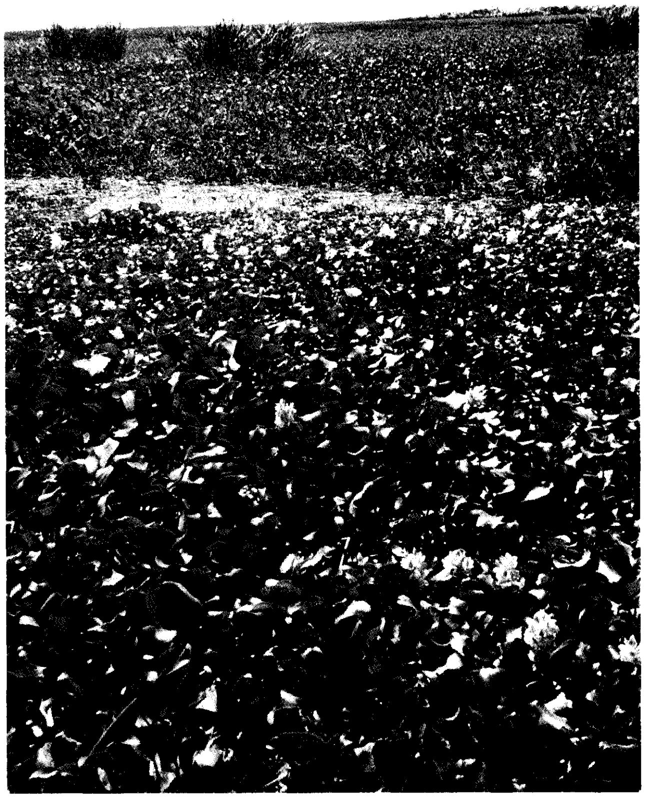


Figure 9. A swampy area on a delta lobe. A small stream flows from the standing water. Note blooms on the hyacinths [1995].

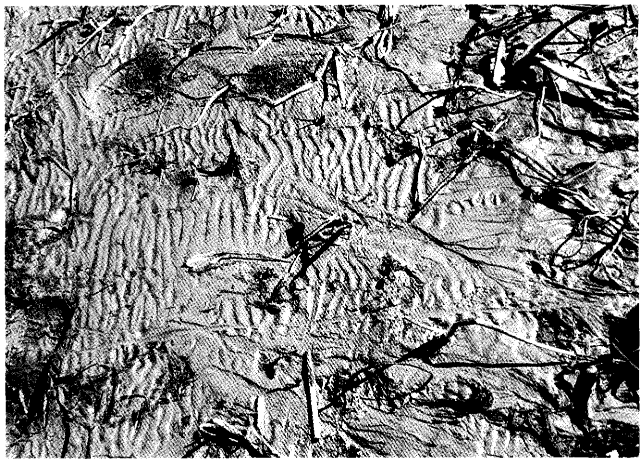


Figure 10. Wave ripples on the newly-deposited sediments on the delta lobe. Note the footprints on the left side of the figure. The soft sediments will not support any sustained substantial weight [1995].

worldwide catastrophe would have the volume of water necessary to provide the quantity of sediment needed to form the huge "delta" features found in the geologic column. Some of these arguments, and alternately suggested depositional modes, were reviewed by Williams, Chaffin, Goette and Meyer (1994).

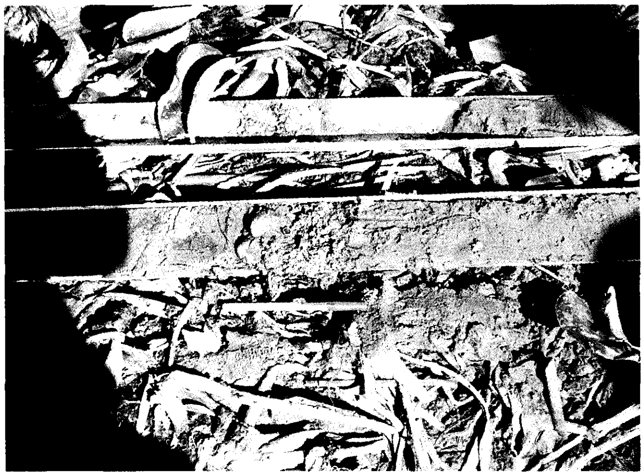


Figure 11. Lower portion of a vibracore sample from a delta lobe consisting of clay and organic matter typical of a coastal mudflat to the left. Upper portion of a vibracore sample illustrative of a delta-building (regressive) phase to the right. A transgressive phase of a vibracore sample (above ball point pen) consisting of shell hash-possibly a storm deposit [1995].

Also the rapid continuing progradation of the Mississippi River delta complex has been employed by creationists as evidence for a young earth. Calculating the amount of sediment transported by the Mississippi in a year, it is sufficient to cover an area of one square mile to a depth of 267 feet [81 m] (Coffin, 1983, p. 334). Determining the size of the Mississippi Delta in the 1860's-1870's, it was found that this land mass had likely formed in the last 4,000-6,000 years! Also see Allen (1972), Heinze (1977) and Mehlert (1988). Rapid delta formation in southeastern Louisiana suggests a youthful Mississippi River.

Acknowledgments

The following people offered helpful comments on the manuscript: Jack Cowart, Carl Froede, Jr. and John Reed. The opinions expressed in this letter remain solely those of the author.

Appendix I

Transgression and Regression?

The growth of the Atchafalaya and Wax Lake deltas is considered a regressive phase. While on the delta lobe, a vibracore* sample of the sediments was obtained. The lower portion of the sample is a typical cross-section of a coastal mudflat (Figure 11). The regressive or delta-building portion of the sample is also shown in Figure 11. Between the coastal mudflat section and the delta-building section of the sample was an approximately 3.5-inch [8.9 cm] layer of shell hash — likely a storm deposit. This portion is considered transgressive since the shell hash was deposited by marine water.

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*A hollow aluminum alloy pipe is vibrated into the soft sediments. then removed with a considerable depth of sediment. The pipe is cut in half lengthwise after removal and the sample cross-section can be examined either visually or employing x-ray techniques.

Are transgressions and regressions a possible explanation of interfingered continental and marine sediments in the late stages of the Flood? Suppose during this period fresh, soft sediments were washed into newly-formed rivers and the suspended load was transported toward the retreating Flood water. Would "continental" material be deposited at the mouth of the river at low tide? Later at high tide, would the Flood water transgress over the newly-deposited "continental" sediments overlaying "marine" sediments? Or were both so-called continental and marine sediments interbedded by the Flood without any necessity to resort to the transgression and regression concept? Some discussion of the subject is included in Williams and Howe (1993, p. 51).

References

CRSQ - Creation Research Society Quarterly.
Allen. B. F. 1972. The geologic age of the Mississippi River. *CRSQ* 9:96-114.
Austin, S. A. (editor). 1994. Grand Canyon: Monument to catastrophe. Institute for Creation Research. Santee, CA.
Coffin, H. G. 1983. Origin by design. Review and Herald Publishing. Washington, DC.
Coleman, J. M. n.d. The Mississippi Delta: Model for subsurface exploration (video). American Association of Petroleum Geologists. Tulsa.
Coleman, J. M. and D. B. Prior. 1982. Deltaic environments of deposition in Scholle, P. A. and D. Spearing (editors). Sandstone depositional environments. American Association of Petroleum Geologists. Tulsa. pp. 139-178.
Heinze, T. F. 1977. Delta formation, history and arithmetic. *CRSQ* 14:77.
Kolb, C. R. and J. R. Van Lopik. 1966. Deltaic environments of the Mississippi River deltaic plain—Southeastern Louisiana in Shirley, M. L. and J. A. Ragsdale (editors). Deltas in their geologic framework. Houston Geological Society. pp. 17-61.
Mehlert, A. W. 1988. Another look at the age and history of the Mississippi River. *CRSQ* 25:121-123.
Roberts, H. H. 1995. Atchafalaya-Wax Lake deltas: The new regressive phase of the Mississippi River delta complex. A field trip for the 1995 GCAGS annual meeting. Gulf Coast Association of Geological Societies. Austin, TX.
Roberts, H. H., R. D. Adams and R. H. W. Cunningham. 1980. Evolution of sand-dominated subaerial phase, Atchafalaya Delta. Louisiana. *The American Association of Petroleum Geologists Bulletin* 64:264-279.
Shlemon, R. J. 1975. Subaqueous delta formation - Atchafalaya Bay, Louisiana in Broussard, M. L. (editor). Deltas: Models for exploration. Houston Geological Society.
Swanson, D. C. 1983. Deltaic reservoir facies: A collection of practical and useful information for the subsurface geologist. Earth Enterprises. Austin, TX.
van Heerden, I. L., J. T. Wells and H. H. Roberts. 1983. River-dominated suspended-sediment deposition in a new Mississippi delta. *Canadian Journal of Fisheries and Aquatic Science* 40 (Suppl. 1):60-71.
——————— and H. H. Roberts. 1988. Facies development of Atchafalaya Delta, Louisiana: A modern bayhead delta. *The American Association of Petroleum Geologists Bulletin* 72:439 453.
Williams, E. L. and G. F. Howe. 1993. Fossil wood of Big Bend National Park, Brewster County, Texas: Part I - geologic setting. *CRSQ* 30:47-54.
——————— E. F. Chaffin, R. M. Goette and J. R. Meyer. 1994. Pine Creek Gorge, the grand canyon of Pennsylvania: An introductory creationist study. *CRSQ* 31:44-59.

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BOOK REVIEW

The Scandal of the Evangelical Mind by Mark Noll. 1994. Eerdmans Publishing Co. Grand Rapids. IVP. Leicester, England. 274 pp. $19.99.

Reviewed by John Goertzen*

According to Noll, (Professor of History and Christian Thought at Wheaton College), a major problem with evangelicals is belief in a recent creation. His book was selected as the 1995 *Christianity Today* Book of the Year. However, this was not based on a popular vote of the general readership as in past years, but on "250 evangelical scholars, pastors, writers, and other church leaders" specially selected to cast ballots (Wilson, 1995). Whoever these privileged elitists were, we can be sure that not many creationists were considered. This article will deal with Noll's attack on creation.

Noll does not help whatever *scandal* there is with *the evangelical mind* when he wrongly claims that "no responsible Christian teacher in the history of the church . . . before this century [endorsed creationism]" (p. 14). He defines "creationism" as "a theory that the earth is ten thousand or less years old" (p. 13). Surely Noll is familiar with Archbishop James Ussher (1581-1656), a one-time professor at Trinity College, Dublin, who dated the creation to 4004 B.C. This highly respected scholar became the primate of all Ireland in 1634. And he was by no means the lone exception; other chronographers throughout church history have dated the creation of the earth as follows: *Theophilus of Antioch* (third century A.D.) 5509 B.C.; *Julius Africanus* (c. 220-230 A.D.) 5500 B.C.; *Ephraem Syrus* (325-378 A.D.) c. 5500 B.C.; *Bar Hebraeus* (from Armenia, 1226-1266 A.D.) believed Adam "was created on Friday . . . the first month of year one of the existence of the world"; *Joseph Scaliger* (1540-1609 A.D.) 4714 B.C. *John Kennedy* (1752) 4007 B.C.; *William Hales* (1809) 5411 B.C.; and *Henry Fynes Clinton* (1824) 4138 B.C [these are all cited by Anstey, 1913, except Bar Hebraeus, 1932]. Many others undoubtedly could be found. The first century Jewish historian, Josephus, says that "from the generation of Adam, until [the destruction of] the temple, there were three thousand five hundred and thirteen years . . ." [10, 8. 5] (Josephus, 1960, p. 220). The context clearly indicates that the *generation of Adam* was at the beginning of time. Noll's mistake is due to his reliance on the flawed history of Ron Numbers (pp. 13-14).

Noll himself cites the unnamed editor of the *New York Observer* who, in 1863, defended the *traditional interpretation* of Scripture "(e.g., that humanity was six thousand years old)" (p. 183). There Noll is trying to say that creationism is an outmoded primitive belief of Christianity. Noll cannot have it both ways: the young earth cannot be both the traditional belief of Christianity *and* the result of prophecy by Ellen G. White, a Seventh Day Adventist prophetess. Moreover

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Numbers's claim that Flood geology (a vital component of modern creationism) was invented by Seventh Day Adventists is not true (though Noll has endorsed Numbers, see also pp. 188-9). Historian Rodney Stiling (1995) has observed that *Scriptural Geologists,* from both the U. S. and Britain, advanced theories remarkably like the later Flood geology model decades earlier than White's prophecies.

Noll's account of the evolution of the American University from Christian belief to modern unbelief is fascinating and compelling (pp. 110-114). Evangelicals might take care that history does not repeat itself for those schools that still have a Christian commitment. He also cites Wuthnow's observation "that the deep structures of modern intellectual life are shaped largely by the works of non- or anti-Christians" (p. 17). If the foundations of modern universities are built on *anti-Christian* beliefs, how is the Christian supposed to effectively build on such a foundation? Noll recognizes some of these problems saying that if evangelicals are open about the implications of their beliefs it could "create prejudice against them" (p. 22), and, "higher learning has often been a snare to faith" (p. 31).

Noll criticizes fundamentalists for rejecting the science of the main culture (pp. 185-186), yet he has admitted it (or modern intellectual life, at least) is based on anti-Christian ideas. Creationists agree with him that Christians are to "look at the natural world" but the $25,000 question is, *how should it be interpreted?* Noll cites Psalm 19:2,4 (p. 53, see also pp. 204 and 207) to say that we find out about the world "by looking at the world, and not by prying specific information from the Scriptures." However, one of the "consequential evangelical scientists" that he cites (p. 185), Matthew Maury, achieved his success precisely by prying specific information from Scripture and then observing the natural world in a believing work of faith. Maury, the father of oceanography, received his inspiration from Psalm 8:8 ". . . whatever passeth through the paths of the seas." Maury was convinced that if the Bible said there were paths in the seas, they could be discovered and charted. He was criticized by some for using Scripture in support of his scientific ideas. He replied:

> I have been blamed by men of science, both in this country and in England, for quoting the Bible in confirmation of the doctrines of physical geography. The Bible, they say, was not written for scientific purposes, and is therefore of no authority in matters of science. I beg pardon! The Bible is authority for everything it touches (cited by Meyer, 1982, p. 98).

I realize that there were some who cited Scripture in defense of geocentricism during the 16th century (and even today); there is always a danger of misinterpretation, but if we are going to be fair the success stories such as Maury should also be told.

Noll grants that fundamentalists preserved essential elements of the faith (p. 131), but still calls it an "intellectual disaster." Does he mean to say that those who abandoned the essentials of the faith did not have an "intellectual disaster," only those that preserved them? I would not say fundamentalism was all that it might have been, but I would rather retain and build on the foundation of those who possessed true Christian faith, than discard it for an edifice constructed on unbelief. Fundamentalism was not similar to Chairman Mao's cultural revolution (p. 144) which shot educated men and burned all books except Mao's sayings. On the contrary, fundamentalists were named for a series of books they produced (distributing for free!) and also started many institutions of higher learning.

There is room for improvement with fundamentalist scholarship but much has been accomplished with limited resources, contrary to Noll's claims (p. 137). For the history and philosophy of science there is Morris's excellent *The Biblical Basis of Modern Science* (1984), and an astute recent effort by Pearcey and Thaxton; *The Soul of Science* (1994).

The claim that creationists have held on to Baconian science (a naive induction) is simply not true (p. 181, 186). Fundamentalist creationists were in the vanguard of exposing the presuppositional nature of all thought (Francis Schaeffer and Gordon Clark, *The Philosophy of Science,* 1964, pp. 56-62 especially).

Noll makes existentialist sounding claims, having trouble believing in objective truth (see statements on p. 88; p. 184, criticism of "hard-edged facts;" and p. 196, "nineteenth century procedure"). He states, "any theology that encourages Bible reading . . . primarily to understand a "world out there," instead of "the world for me," is not only [advocating] bad theology but a theology prejudicial to the intellectual life" (pp. 142-3). Consider his similarity to Royce Gruenler describing Gadamer's existentialist hermeneutic (1984):

> True interpretation of the historical Jesus must be existential, that is in terms of my needs and questions; hence the historical Jesus becomes . . . the contemporaneous Jesus for me. There is for Gadamer [an existentialist] no objective revelation from outside history.

We should not look for the objective, real Jesus; only the contemporaneous Jesus for me (Just like Noll says about creation, Bible reading for the world for me). If evangelicals are going to reject existentialist methodology for the New Testament, should they adopt it for the Old Testament?

Noll lauds Warfield's compromise with evolutionary science (p. 206) but it resulted in the loss of all the mainline denominations and their schools. Machen, who faced the results of that accommodation, said:

> . . . the liberal attempt at reconciling Christianity with modern science has really relinquished everything distinctive of Christianity . . . In trying to remove from Christianity everything that could possibly be objected to in the name of science, in trying to bribe off the enemy by those concessions

> which the enemy most desires, the apologist has really abandoned what he started out to defend. (1923, pp. 7-8)

and also:

> Modern materialism . . . is not content with occupying the lower quarters of the Christian city, but pushes its way into all the higher reaches of life . . . Mere concessiveness, therefore, will never succeed in avoiding the intellectual conflict (1923, p. 6).

If Noll wants Phillip Johnson to be heard (p. 197), why was he not invited to *The Evangelical Engagement with Science* held at Wheaton in 1995? The young-earth *International Conference on Creationism* scheduled Johnson for a keynote address in 1994. Johnson was also attacked in print by the American Scientific Affiliation (Murphy, 1993) [the ASA is praised by Noll, p. 229] but favorably treated by the creationist *Bible Science* News (33:7, September 1995) and *Creation Ex Nihilo* (18(l), December 1995). Hence, who is making it difficult for Phillip Johnson to be heard?

Noll calls creationism "scientific dispensationalism" (p. 195) for believing in physical changes caused by the Fall and Flood. If this claim is true, then Noll and his fellow naturalists (whether of the theistic or atheistic variety) are the hyper-dispensationalists of science accepting many more epochs more different than those believed in by creationists.

Noll connects the questions of the age of the earth with human origins (pp. 196, 207). This is interesting because the current majority evangelical position concedes the old earth but wants to hang on to the divine origin of humans. I believe they will be no more successful than the 19th century compromisers with science. Those evangelicals who still believe will one day wake up in a situation similar to what Machen encountered in the mainline denominations, only this time within evangelicalism.

Noll cites Warfield's evaluation of John Calvin as an evolutionist (p. 207). If this is true, Calvin believed it all happened in "little more than 5000 years" (cited by Van Bebber and Taylor, 1994, p. 120), much like many other leading church fathers! Contrary to Noll's claim (p. 244), 2 Timothy 3:16 does emphasize the Bible as a source of detailed knowledge. "All Scripture is God-breathed and is profitable for teaching." How can Scripture be profitable for teaching if we cannot be sure of what it says (as Noll states pp. 200-201)? He expects us to be able to understand his reasoning and vocabulary; why are the most basic Scriptures more inscrutable than his words? We can be certain of the clear meaning of Scripture's account of the earth's recent origin and early history affirmed throughout most of church history.

References

Anstey, Martin. 1973. Chronology of the Old Testament. Kregel. Grand Rapids, MI. Original copyright 1913.

Bar Hebraeus. 1932. The Chronology of Gregory Abu'l Faraj. Oxford University Press. London. Translated by H. Milford.

Gruenler, Royce. 1984. Response to the new hermeneutic. In Radmacher, Earl and Robert Preus, editors, Hermeneutics, inerrancy, and the Bible. Zondervan. Grand Rapids, MI. pp. 573 90.

Josephus, Flavius. 1960. Josephus: Complete works. Translated by William Whiston. Kregel. Grand Rapids, MI.

Machen, J. Gresham. 1956. Christianity and liberalism. Eerdmans. Grand Rapids, MI. Originally published in 1923 by The Macmillan Company.

Meyer, John. 1982. The life and philosophy of Matthew Fontaine Maury, Pathfinder of the seas. *Creation Research Society Quarterly* 19:91-166.

Stiling, Rodney. 1995. Scriptural geology in America. Public address given at The Evangelical Engagement with Science, Wheaton College, March 30-April 1, 1995.

Van Bebber, Mark and Paul Taylor. 1994. Creation and time: A report on the progressive creationist book by Hugh Ross. Eden Publications. Mesa, AZ.

Wilson, John. 1995. The 1995 CT book awards. Christianity Today 39(5):25.

PANORAMA NOTE

Can Evolutionists Now Explain the Earth's Magnetic Field?

Until recently, creationists could take great pride in the fact that we have had the only *workable* explanations for the origin, past reversals, and present decay of the earth's magnetic field (Barnes, 1973; Humphreys, 1983, 1984, 1986, 1988, 1990a, b, 1993). Some creationists see my theory as being entirely separate from Dr. Barnes's, but I regard my theory as a generalization of Dr. Barnes's to the case of fluid planetary cores. Other creationists are working on different types of geomagnetic theories, so soon we may have an abundance of workable theories to chose from — a possibility I welcome!

The creationist theories are relatively simple (Dr. Barnes's being more so than mine) and spring naturally from the idea of a young earth. There are still some unsolved problems, particularly with deep precambrian (pre-Flood?) paleomagnetic intensities. But in my biased opinion the creationist theories explain fairly well the general features of the phanerozoic (fossil strata), archaeologic (post-Flood), and historic (17th century to now) magnetic field data.

Evolutionists, on the other hand, must explain the survival of the field over the billions of years they allege the earth has existed. For nearly 50 years, they have claimed in various theories that convection (heat-driven) motions of the electrically conducting fluid in the earth's outer core act like an electric generator (or "dynamo"), producing the billion ampere electric current in the core which causes the magnetic field.

One problem with these "self-sustaining dynamo" theories has been that they were *incomplete.* Despite decades of hard work by many diligent theorists, the theories were so complex that no one had shown a self-sustaining dynamo could actually work under conditions in the earth's interior. This lack of completeness did not prevent evolutionists from making exaggerated claims about their theories to the public. But informed creationists already knew what one dynamo theorist, Peter Olson of Johns Hopkins University, recently acknowledged (Ladbury, 1996): "The convection-driven geodynamo was rapidly becoming gospel without anyone actually demonstrating that it could work."

Olson probably felt freer to admit this lack publicly because he thought he could speak in the past tense. Recently Gary Glatzmaier of Los Alamos National Laboratories and Paul Roberts of UCLA made a big step toward demonstrating a working dynamo theory (Glatzmaier, 1995a, b). Using 2000 hours of supercomputer time at the NSF Pittsburgh Supercomputing Center, they simulated 40,000 years of convection motions and magnetic fields in the earth's core. Starting with a fairly strong toroidal (lines of force wound east west as on a ball of twine) magnetic field located only in the core, and assuming a reasonable heat flow from the core, the simulation developed a dipole (north-south) field outside the core, similar to today's field. Near the end of the simulation, the field went though a polarity reversal, taking a few thousand years to do so. It was a massive, well done calculation, and dynamo theorists have reason to be happy about the results. However, there are a few things which dissatisfy me about the calculation:

(1) The authors assumed a high electrical conductivity for the core fluid, 400,000 to 600,000 mhos per meter. These numbers are fashionable among dynamo theorists, but they are more than ten times larger than estimates based on laboratory measurements of the materials supposed to be in the core, about 30,000 mhos per meter (Stacey, 1967). This is important because the more conductive the core fluid, the less work the fluid flows must do to maintain the field against resistive losses, that is, with more realistic conductivities, the simulation would be more likely to fail.

(2) The simulation says that presently within the core there should be a strong toroidal magnetic field of about 150 Gauss. Yet recent measurements weigh heavily against the toroidal field being more than one-tenth that value (Lanzerotti, 1986).

(3) The simulation gives no net westward drift of the small-scale features of the earth's magnetic field, contrary to observation (Bloxham and Gubbins, 1985).

(4) The new simulation does not seem capable of reproducing the "extraordinarily rapid" changes in the earth's magnetic field during reversals indicated by the paleomagnetic research of Robert Coe and Michel Prevot (1989, 1995). The simulation's fluid velocities are only a few tenths of a centimeter per second, whereas the general opinion (including my own) is that flow rates a thousand times greater would be necessary to reproduce Coe and Prevot's results. This indicates that past core conditions were drastically different from today — catastrophically different!

Anyone who has run large, complex codes on supercomputers (as I have) knows that there can easily be hidden flaws which take years to discover and which completely invalidate the early results. We could have more confidence in this calculation if several different codes were to give similar results. Other groups are working on the problem, but since the amount of computer time needed is so great, it could take many years to know (a) whether this result is correct and (b) how sensitive it is to its initial assumptions. As one theorist remarked (Ladbury, 1996), "We have to look at this as a long-term project."

Even if the simulation turns out to be correct, it would merely mean we now have two classes of possible explanations for the earth's magnetic field — one evolutionist and one creationist. Then it would be merely a question of which class explains the data better. In view of the past successes of creationist models and the past failures of the self-sustaining dynamo theories (Humphreys, 1984, 1990b), I am betting on the creationist theories.

References

CRSQ — Creation Research Society Quarterly.

Barnes, T. G. 1973. Electromagnetics of the earths field and evaluation of electric conductivity, current, and joule heating of the earth's core. *CRSQ* 9:222-230.

Bloxham. J. and D. Gubbins. 1985. The secular variation of Earth's magnetic field. *Nature* 317:777-781.

Coe, R. S. and M. Prevot. 1989. Evidence suggesting extremely rapid field variation during a geomagnetic reversal. *Earth and Planetary Science Letters* 93:292-298.

Coe, R. S., Prevot, M., and P. Camps. 1995. New evidence for extraordinarily rapid field change during a reversal. *Nature* 374: 687-692.

Glatzmaier. G. A. and P. A. Roberts. 1995a. A three-dimensional self-consistent computer simulation of a geomagnetic field reversal. *Nature* 377:203-209.

Glatzmaier, G. A. and P. A. Roberts. 1995b. A three-dimensional convective dynamo solution with rotating and finitely conducting inner core and mantle. *Physics of the Earth and Planetary Interiors* 91:63-75.

Humphreys, D. R. 1983. The creation of the earth's magnetic field. *CRSQ* 20:89-94.

Humphreys, D. R. 1984. The creation of planetary magnetic fields. *CRSQ* 21:140-149.

Humphreys, D. R. 1986. Reversals of the earth's magnetic field during the Genesis flood. In Walsh, R. E. and C. L. Brooks, and R. S. Crowell (editors). Proceedings of the First International Conference on Creationism, Vol. II, pp. 113-126. Available from Creation Science Fellowship, 362 Ashland Avenue, Pittsburgh, PA 15228, USA.

Humphreys, D. R. 1988. Has the earth's magnetic field ever flipped? *CRSQ* 25:130-137.

Humphreys, D. R. 1990a. Physical mechanism for reversals of the earth's magnetic field during the Flood. In Walsh, R. E. and C. L. Brooks (editors) Proceedings of the Second International Conference on Creationism, Vol. II, pp. 129-142.

Humphreys, D. R. 1990b. Good news from Neptune: the Voyager II magnetic measurements. *CRSQ* 27:15-17.

Humphreys, D. R. 1993. The earth's magnetic field is young. Acts *and Facts* 22(8):i-iv. (ICR Impact Article No. 242) Available from Institute for Creation Research, PO. Box 2667, El Cajon, CA 92021.

Ladbury, R. 1996. Geodynamo turns toward a stable magnetic field. *Physics Today* 49(1):17-18.

Lanzerotti, L. J., et al. 1986. Measurements of the large-scale direct-current earth potential and possible implications for the geomagnetic dynamo. *Science* 229:47-49.

Stacey, F. D. 1967. Electrical resistivity of the earth's core. *Earth and Planetary Science Letters* 3:204-206. This estimate agrees well with Barnes's (1973) calculation of 40,000 mhos per meter based on the observed rate of decay of the earth's magnetic field.

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CATASTROPHISM AND MODERN GEOLOGY: MODELING THE PLACER GENERATION PROCESS

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Abstract

We present a mathematical model for coastal submarine placer (CSP) generation under lateral coastal drift conditions. We test the model against field data and propose a method of predicting CSP parameters which has possible economic application for locating placer deposits. The model provides a method to estimate the time and rate of CSP formation. The model yields an age for a tin-bearing sediment in northeastern Siberia to be less than 40,000 years. This estimate is approximately 1000 times less than age given by the standard evolutionary geology time scale. A logical extension of this work is to two and three dimensions. This would make possible more detailed comparison of the models with field data and produce improved methods for estimating placer parameters.

Introduction

Elucidating the role of catastrophism from available field data is a massive task indeed. Our approach has been to focus on a specific process and to combine modeling with testing of the model against actual field data. We selected one of the least investigated topics of geological process theory—the process of placer formation.

A correct understanding of the generation mechanism, as well as the age and duration of both alluvial and submarine placers we believe is closely connected with catastrophic geologic activity. Modeling placer formation is therefore important both in prospecting and for a correct understanding of geological history.

During the period 1983-1990, the authors researched the geochemistry and lithology of alluvial and submarine placers in Middle Chucotka, northeastern Siberia. Local geologists generally believed the placers of Chucotka had formed through multistage processes of long duration. However, we contend on the basis of our research, that coastal submarine placers (CSP) need much less duration for their formation. This mechanism of short duration provides a successful description for at least CSP's.

In this paper we consider a mathematical model for transport by lateral coastal drift (LCD), that describes the generation process for coastal submarine placers (CSP). We test our model against actual field data.

Our model for load migration describes: 1) arrival of fragmented material into the active drift zone of beach and submarine slope and 2) transport by lateral drift with irreversible dispersal from the shore to the submarine environment.

Mathematical Model

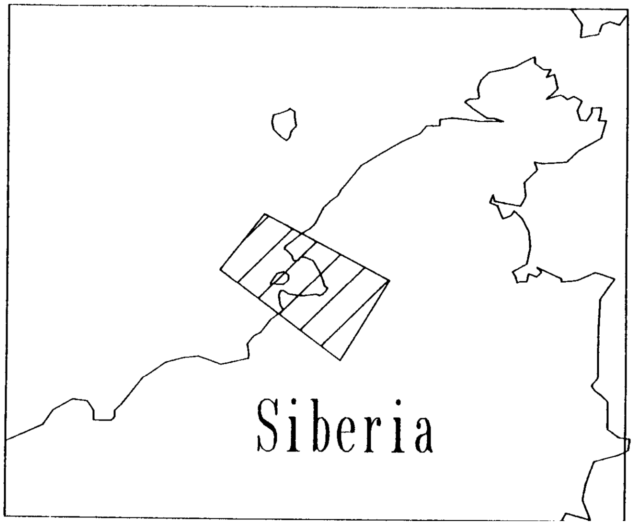

Figure 1. Research district.

We choose, for inclusion in the initial differential equations, an elementary cell having a vertical height H (direction corresponding to the thickness of the active layer of sediments), length ΔX (with the x-axis positive in the drift direction and parallel to the shore line), and active accommodation zone width Y (Figure 4). Material from land enters through the side ΔXH with velocity U. The amount of load (Per unit volume) carried into the cell by lateral drift from the direction of drift is VHY, where V is the drift velocity. The amount of load transported out of the cell through the downdrift side is $VHY + (\delta(VHY)/\delta x)\Delta X$. An amount $WH\,\Delta x$ of load leaves the cell through the oceanward side of the cell parallel to the shore (W is the velocity of this material exiting this side of the cell). The velocity is different for light (W) and heavy (W_p) fractions of the sediments. Here we use a subscript p to denote the ore material.

For simplicity, we replace the actual lateral drift rate, which is pulsating in time, with a steady one that has constant parameters for the material migration through the cell. Let us assume that all parameters are constant along the coastal zone under study except the content C of heavy (ore) minerals and the width Y of the active accumulation zone. Then we equate to zero the difference of material carried into and out of the cell and divide the whole expression by the constant quantities ΔX and H to obtain the following expression for all migrating material:

$$\frac{\delta Y}{\delta x}V+W-U=0 \qquad (1)$$

For the ore minerals in the flux of ore-bearing material (x_0x_1) we have:

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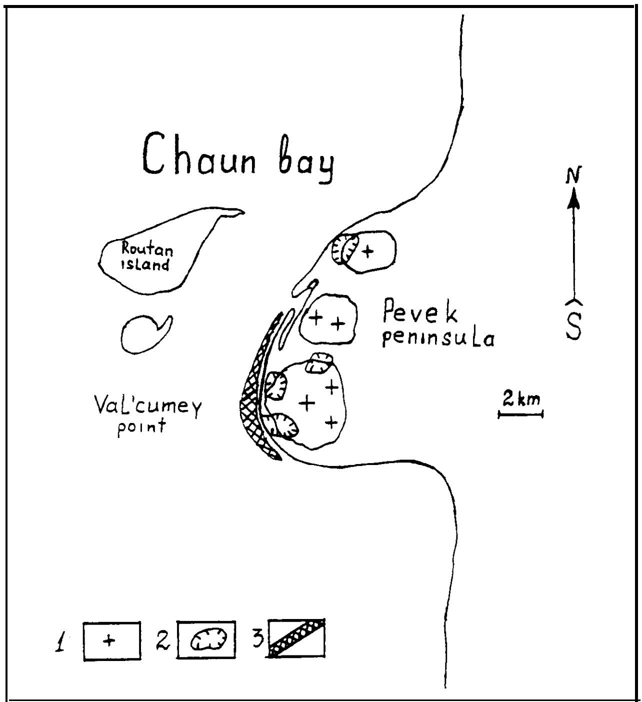

1. Granite instusions. 2. Tin ore fields.
3. Coastal submarine placer of tin.

Figure 2. Map of Pevek peninsula.

$$\frac{\delta(CY)}{\delta x}V+CW_p-C_pU = 0 \qquad (2)$$

C_p represents the average content of ore minerals in the incoming ore-bearing material.

In the direction of the drift where ore-bearing material is absent ($x > x_l$) we have:

$$\frac{\delta(CY)}{\delta x}V+CW_p = 0 \qquad (3)$$

Then we solve equation (1) for Y and obtain:

$$Y = Y_0+BX \qquad (4)$$

where B = (U - W)/V. Let $Y_0 = 0$, substitute (4) into (2), (3) and solving for C (see the Appendix for details) we obtain:

for the segment x_0x_1:

$$C = KC_p(1-(\frac{x_0}{x})^A) \qquad (5)$$

where:

$$K = U/(U-W+W_p) \qquad (6)$$

$$A = (U-W+W_p)/(U-W) \qquad (7)$$

for the segment $x > x_1$

$$C = KC_p(x_l^A-x_0^A)/x^A \qquad (8)$$

It is important to note that this model may be used for the description of lateral migration of any material; for example, marker pebbles. In this case one must in all formulas change C to C_m, C_p to 1 (100% ore), W_p to W_m, A to A_m, K to K_m. We designate the flux of incoming marker rock pebbles as x_2x_3. Here we use the subscript m to denote marker pebbles.

A test of the adequacy of the model was conducted in several tin bearing districts of the northeastern Siberian coast. One of them is located a short distance from Val'cumey point in Chaun Bay and is associated with actively denudated relief in the southern part. Abrading cliff and friable slope sediments arriving in the active zone of the beach are tin bearing. Lateral coastal transport is directed from the top of the point to the north. In the northern part of the district lateral coastal drift occurs and a placer ore zone is formed. CSP of tin is directed from the source north in accordance with the concept of lateral coastal drift (LCD).

Almost all the layers of the coastal submarine deposits are tin-bearing, but the highest concentrations of cassiterite are deposited as lenses and currents parallel to the modern shoreline.

Cassiterite (SnO_4) concentrations are located in the pebble, sand, and silt deposits of the beach and submarine slopes. The average dimension of cassiterite grains is 0.31 mm. The grain dimensions are different for the different types of deposits: pebble deposits contain more large dimension ones (average 0.54 mm), sand—0.18 mm silt—0.13 mm. The highest concentrations of cassiterite are associated with sand and pebble deposits.

Modern lithodynamical characteristics of LCD near the Val'cumey point are described as non-satiated loads (abrading zone). Far to the north coast are more stable (transit zone) and in the north part of the placer we see the deposition of loads on the accumulation forms (accumulation zone). The highest concentrations of cassiterite and the greater part of occurrence volume are associated with the abrading zone.

We could not research the lithodynamical conditions of the past as well as the modern conditions, but drilling data have shown that similar conditions occurred in this region.

The cassiterite concentrations in the active layers of sediments in the abrading and transit zones are dynamical, that is concentrations are conditioned by arriving and departing material. Tin content in every point of the active layer is constant (with some fluctuations) until the velocities of arriving and departing material are stable.

Figure 5 shows results of measurement of the content of tin and marker pebbles and model calculations for each. The values for the model coefficients are obtained for the descending branch of the curves in the following way:

The constants:

$$D = KC_p(x_1^A-x_0^A) \qquad (9)$$

and A for tin,

$$D_m = K_m(x_3^{A_m}-x_2^{A_m}) \qquad (10)$$

and A_m for marker pebbles were calculated in the intervals $x > x_1$ and $x > x_3$ respectively, in the conventional manner by a trial and error method as coefficients of regression equations:

$$C(X_1) = \frac{D}{x_i^A} \qquad (11)$$

$$C_m(X_1) = \frac{D_m}{x_i^{A_m}} \qquad (12)$$

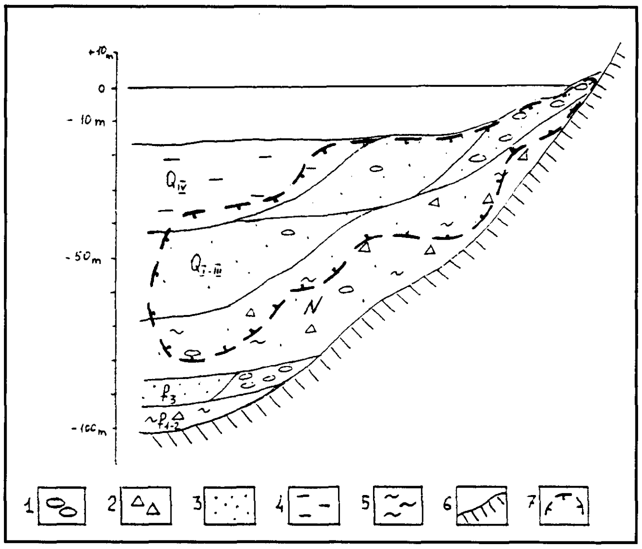

Figure 3. Diagrammatic representation of a section through the coastal submarine deposits near the Val'cumey point. Legend: 1. Pebbles. 2. Detritus. 3. Sands. 4. Silt. 5. Clay. 6. Shale. 7. Placer deposits. P_{1-2} - paleocene-eocene; P3 - oliogocene; N - miocene-Pliocene; Q_{I-III} - pliestocene; Q_{IV} - golocene.

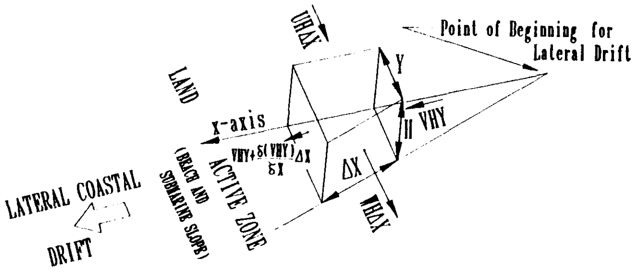

Figure 4. The elementary cell for the mathematical model.

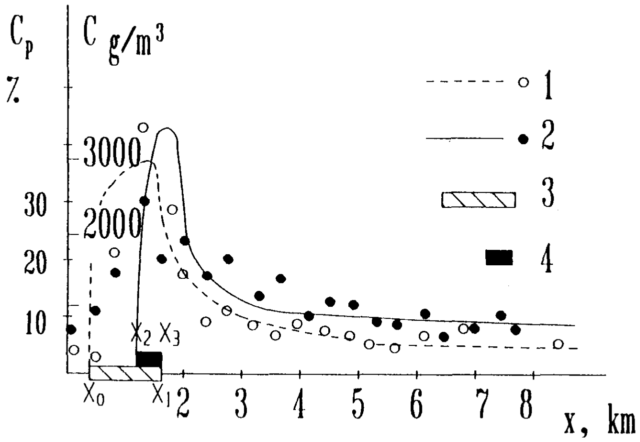

Figure 5. Contents of tin and granite marker pebbles. Natural contents: 1 - tin; 2 - granite pebbles and approximated curves. Districts where new material joins the lateral coastal drift: 3 - tin, 4 - granite detritus.

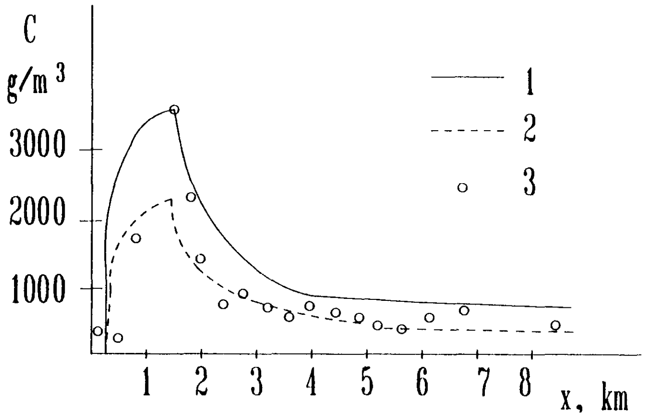

Figure 6. Calculated curves for tin based on the model equations. Constructed: 1 - with data from drilling in submarine sediments near the point Xl = 1200 meters from the beginning of lateral coastal drift, 2 - with data from geochemical sampling of friable slope sediments near the shoreline, 3 - natural contents of tin.

These coefficients and known quantities x_0, x_1, x_2, x_3, C_p are used for the calculation of the K and K_m values.

For Val'cumey district, these coefficients are A = 1.65, $A_m = 1.50$, $D = 3.4 \times 10^8$, $D_m = 1.8 \times 10^6$, with $x_0 = 200$ m, $x_1 = 1200$ m, $x_2 = 1160$ m, $x_3 = 1200$ m, $C_p = 370$ g/m^3. Calculated quantities are $K_m = 8.8$ and $K = 8.0$.

The near equality of the coefficient values K_m, K and A_m, A for tin and pebbles suggests a method for predicting tin content in coastal submarine sediments under lateral drift conditions. The less than 10% difference in coefficients allows one to apply routine geological prospecting methods. The coefficients K_m and A_m, are calculated with this method and then used for tin. If we know the values (x_0, x_1, C_p) of the tin bearing source, then we can calculate the tin content in the coastal submarine sediments. C_p is obtained from geochemical sampling of friable slope sediments arriving at the active zone of the beach or from data from drilling into submarine sediments in the vicinity of point x_1. The results of the modeling are seen in Figure 6.

One of the curves is constructed using drilling data from submarine sediments in the vicinity of point $x_1 = 1200$ m from the beginning of lateral coastal drift. The other curve is obtained using data from geochemical sampling of friable slope sediments from the shoreline. Geochemical sampling gave the estimate $C_p = 250$ g/m^3. To calculate C we used coefficients K_m and A_m obtained from data giving the content of granite marker pebbles. Sufficient conformity of the calculated and actual data argues that this model is useful for predicting parameter values for CSP as the initial stage of geological prospecting. The correlation coefficient for calculated and field data is 0.82 (the critical value for the 1% level of significance is 0.62) which indicates a genuine correlation between the model and the actual processes.

From this model, we can obtain the time interval T for placer deposit generation within an active layer for deposits of thicknesses up to 2 meters:

$$T = L/V$$

where L is the length of the placer deposits and V is the velocity of lateral drift.

The T for Val'cumey placer deposits L is about 8000 m, V calculated in two different ways (with drift velocity for sands and pebbles) is 100 m per 24 hours, thus T for Val'cumey placer deposits is 80 days.

The dynamical nature of heavy mineral anomalies has been corroborated many times on the different natural objects (Mero, 1969; Gardner, 1955). As usual,

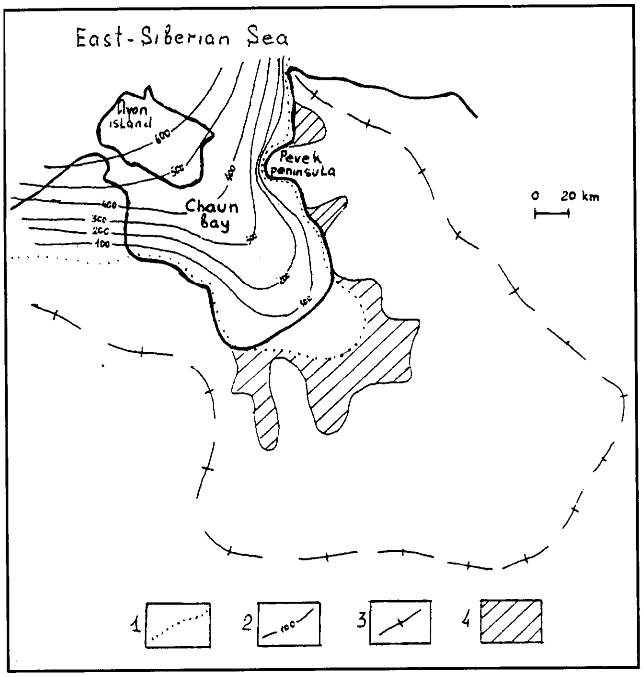

Figure 7. Lithodynamic condition of Chaun depression and mountain setting. Legend: 1 - border of Chaun depression (sedimentation zone); isolines of sediment thickness (in m) based on geophysical and drilling data; 3 - border of denudation zone relating to the Chaun depression; 4 -transit zone without considerable denudation or sedimentation.

the velocity of sedimentation was understated and the time interval for placer deposit generation was overestimated.

Recent research on sedimentation shows that generation of massive thicknesses of stratified sediments can occur in a short time interval (Julien, Lan, and Berthault, 1993). Under the conditions of rapid subsidence of a sedimentation basin, fast burial of the generated placer deposits can occur. Thus one can observe accumulation of massive ore-bearing sedimentary thicknesses that exceed by many times the thickness of individual placers layers. We see such a situation in the tin CSP's within a short distance from Val'cumey point. Tin content in the sediment column (thickness more than 30 m) is consistent enough (the coefficient of variation is 1.51). The tin content in the active layer correlates well with the average tin content in the entire thickness of the placer deposits (the correlation coefficient is 0.74 and the critical value for the 1% level of significance is 0.54). Such stability of tin content in the column is evidence of constant litho-dynamical conditions throughout the period of placer deposit generation and accordingly proves the recent age of its generation. This is because the litho-dynamical factor is the most unsteady of all the geological factors. Variation of the tin content in the sedimentary column and the localization of the increased tin content to layers of coarse sediments is explained as a result of stream pulsation (Julien et al., 1993).

Past estimates of the duration of placer deposit generation were based on paleontological data and the overall geological history of the East Arctic region. The authors attempted to estimate the duration of placer deposit generation on the basis of the balance of the volume of material from land denudation arriving offshore and the volume of accumulated material in the Chaun depression (Figure 7). The approximate calculation of placer deposit generation duration based on the estimated northeastward velocity of denudation of 1 mm per year gives a greatest possible duration of 40,000 years, which is approximately 1000 times less than the age estimated from paleontology. If we take into account that the velocity of denudation may have been much greater in the past, especially in the post-Flood time (Nevins, 1974), then this age is an upper limit and the real age may be much less. More exact estimates of the age of the sediments and also the velocity of placer generation perhaps can be calculated through future research.

The scientific literature contains several efforts to model the placer generation process. However, most of these are based on heavy use of geological prospecting data and most have difficulty in calculating practical parameters. An important distinctive feature of our method is that it can be applied with much less reliance on drilling. It therefore should be of significant practical interest for the mining industry since it makes the process of prospecting for placer deposits considerably less expensive.

Conclusion

We have presented a mathematical model for generation of coastal submarine placers that successfully predicts the distribution of heavy minerals in placer deposits. The model implies that, under favorable tectonic conditions, massive thicknesses of placer deposits can occur in a brief time interval.

For example, the time span for generating individual placer layers in the much researched Val'cumey placer deposits is estimated as 80 days. The available data show that the age of the entire thickness of these placer sediments is not more than 40,000 years. This upper limit is approximately 1000 times less than the age derived from the standard geological time scale. The actual age may be much less. It means that the true rate of placer generation is dramatically larger than evolutionary geologists usually assume.

This model has enormous practical importance. Creationism is often considered to have little connection with practice. Mathematical model of the placer generation process motivated by a creationist perspective nevertheless offers notable economic benefits. We believe there exist other similar examples in the field of economic geology that if developed, would further the credibility of this understanding of history.

Our model still needs further testing and refinement in both the laboratory and the field. We hope to extend the method to two and three dimensions, to test it in more detail against field data, and to develop improved strategies for estimating placer age and formation rates.

Acknowledgments

We thank the participants in the second Moscow International Symposium on Creation Science, May 27, 1994: Dr. Duane Gish, Dr. Terry Spohn, Dr. Charles Thaxton, and Prof. John Whitmore for their participation in the discussions and favorable regard for our investigation. We want to thank Dr. Eugene F. Chaffin and a reviewer for editing an earlier version of our manuscript, useful notes to its content and improvement in the English.

Appendix: The Derivation of Equation (5).

Substitute the values of B and Y_0 into (4) to get the expression for Y, then substitute for Y in (2) to obtain:

$$\left(\frac{\delta}{\delta x}\left(C\frac{U-W}{V}x\right)\right)V+CW_p-C_pU = 0 \tag{13}$$

Treat U, V, and W as constants. Then C is a function of x, thus the derivative of C times x is C times the derivative of x plus the derivative of C times x. The values of K and A are defined in (6) and (7). Simplifying the equation using these definitions yields:

$$\frac{x}{A}\,\frac{\delta C}{\delta x} = -(C-KC_p) \tag{14}$$

Rearranging and integrating we get:

$$\int\frac{\delta(C-KC_p)}{C-KC_p} = -A\int\frac{\delta x}{x} \tag{15}$$

We put the limits of integration as C = 0 to C = C for the left hand integral and x_0 to x for the right hand integral. After simplification, the integration yields (5).

References

Aleva, G. J. J. 1973. Aspects of the historical and physical geology of the Sunda shelf essential to the exploration of submarine tin placers. *Geologie en Mijnbouw* (Netherlands) 52(2):79-91.

Cobb, Edward H. 1973. Placer deposits of Alaska: An inventory of the placer mines and prospects of Alaska, their history and geologic setting. U.S. Geological Survey Bulletin 1374.

Gardner, D. E. 1955. Beach sand heavy mineral deposits of eastern Australia. Australian Bureau of Mineral Resources, Geology and Geophysics Bulletin 28.

Julien, P. Y., Y. Lan, and G. Berthault. 1993. Experiments on stratification of heterogeneous sand mixtures. *Bulletin de la Societe Geologique de France* 164:649-660.

Lalomov, A. V. and S. E. Tabolitch. 1991. Modelirovanie vdolderefovogo potoka nanosov i prognozirovanie pridrezno-morskih rosspi [Modeling of lateral coastal drift and prediction of inshore-marine placers]. *Vestnik LGU* (Leningrad State University, now known as Petersburg State University), series 7, 3(21): 72-75.

Mero, J. 1969. Mineralnie beogheatestvea okeana [Mineral resources in the oceans]. Progress Press. Moscow.

Nevins, S. E. 1974. Post-Flood strata of the John Day Country, northeastern Oregon. *Creation Research Society Quarterly* 10: 191-204.

LETTER TO THE EDITOR

The Red Fox in Montana and Alberta and The Uniformitarian Geologic Column

I read with interest the article on *Vulpes fulva* (or *Vulpes vulpes)* in the December, 1995, issue of the *Quarterly*. The authors state that “It is currently absent in the grasslands east of the front range of the Rocky Mountains. . . .” Since reading the article, I have inquired of several acquaintances in Montana and Alberta about sightings of the red fox. All have indicated that it has been common during recent decades east of the Front Range in Montana and north into Alberta. From this cursory survey, it is evident that it inhabits the grasslands east of the Front Range at least as far as Great Falls (ca. 90 km). Was the red fox previously absent from this region? One day a couple of years ago, I observed a red fox hunting rodents outside my office window, well within the city limits. Has *Vulpes fulva* adapted to urbanization of its range, or might it have expanded into this area during the past century?

On an unrelated matter . . .

Kudos for John Reed’s article, “Critique of the Naturalist-Uniformitarian System,” in the June, 1996, issue of the *Quarterly*. He put the issue succinctly when he said, “The most severe deficiency in the geologic column is its inextricable linkage to the naturalist-uniformitarian system, and its resulting inability to define and defend its axioms on a metaphysical level (p. 6).” Failure to recognize this fact has hamstrung creationist geologic research to this day. Few have recognized that historical geology is not essentially science, and that condensing the establishment’s scenario into a biblical time-frame does justice to neither science nor Scripture. Reed recognizes this, stating the geologic column “. . . is not merely an empirical model, but instead a comprehensive definition of earth history fundamental to a larger, naturalistic-uniformitarian framework (p. 8).” Acknowledgement that the ultimate debate is over a philosophy of history, not a somehow neutral interpretation of self-evident facts, is long overdue. The expose of the logical inconsistencies of the naturalist-uniformitarian system was well reasoned.

Francis Schaeffer and others have addressed these principles well in past years. But to my knowledge, Reed’s article is the first that applies these principles so directly and effectively to the issue of the geologic column. As I heard Gregory Hull put it, “Most Ph.D.'s are just over-trained technicians.” I agree with him. The American academic establishment is largely obsolete, and Ph.D. degrees are anachronisms, with no real ties to philosophy at all. Many fail, therefore, to recognize that science and history play by different rules. It is refreshing to see capable scientists like John Reed living up to the original standards of science (that branch of philosophy that limits itself to the empirical). It is essential that whenever we face a pivotal issue, such as the veracity of the geologic column, we cut through to the heart of the issue and develop a solid philosophical basis for our research. Reed’s article is a definite step in that direction.

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THE SANDS OF TIME:
A BIBLICAL MODEL OF DEEP SEA-FLOOR SEDIMENTATION

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Abstract

Modern evolutionism requires that the earth be very old. One line of evidence cited is the length of time required to deposit the observed thickness of sea-floor sediments far from any direct continental source. Using the low current depositional rates results in a minimum age of tens of millions of years. The model of deposition presented in this paper differs from the conventional model primarily in the rate of deposition, which is asserted to have peaked at an enormous level during and after the biblical Flood and is presumed to have fallen at an exponential rate to the present low level. Because biblical evidence strongly supports a short historical period between the Flood and the present, the shape of the decay curve is very steep. Data from the Deep-Sea Drilling Project (DSDP) were reinterpreted for this paper. By estimating the thickness of sediment corresponding to this interval and asserting a set of boundary conditions, an analytical model is presented that estimates the age of sediment from a particular depth at a given borehole.

If the modern evolutionary model of deposition is correct, the water temperature evidenced by fossils would show only small, random variations. If a catastrophic event such as the Flood occurred, temporary warming of the water immediately after the catastrophe should have occurred and may be detectable. Fossil evidence of water temperature at the time of deposition is believed by some researchers to correlate with the ratio of oxygen isotopes of mass 16 and 18. Because foraminifera are common in both present-day and ancient sediments and contain oxygen in their carbonate skeletal remains, they are often analyzed for the oxygen isotope ratio and an inferred water temperature is calculated. Based on DSDP data from selected boreholes, and plotted on a time scale modified by the analytical model derived in this paper, a general cooling trend appears plausible from the limited dataset.

Introduction

Near the mouth of a muddy river flowing into the ocean, it is common knowledge that sediments transported by the river slowly settle out of the water and form deposits on the sea floor. In some locations, such as the delta regions near the mouth of the Mississippi River or the Nile River, the build-up of sediments has resulted in the addition of large regions of new land. However, it is less well known that the growth, death, and deposition of microorganisms in the deep ocean have contributed to the formation of sea-floor sediments, particularly in mid-ocean regions. These microorganisms make up the bulk of what is called plankton. Sediments, derived from rock (lithogenous) and various life forms (biogenous), accumulate on the ocean floor and form a record of earth history. If the characteristics of the sediments can be related to events and processes which supplied the sediment, they can be a valuable tool to study earth history.

Scientific research on sea-floor sediments has been actively pursued for over 200 years with a concentrated emphasis during the past 40. Sediment cores have been extracted from the sea floor at locations throughout the earth and analyzed for types of lithogenous material, types of biogenous forms, sedimentation rate, thickness, date of accumulation, and many other interesting features. One of the most interesting fields of research has been the study of paleoclimates using the measurement of oxygen isotopes in the tests from types of microorganisms called foraminifera. This specialized field has developed an explanation for climate fluctuations from warm periods in the Cretaceous, when dinosaurs are thought to have roamed the earth, to cold periods, such as the recent "ice age." Strong attempts have been made to explain the cyclical layering of sediments as caused by periodic occurrences of "Ice Ages" caused, in turn, by orbitally-induced fluctuations in solar heating of the earth.

The time frame offered by the conventional explanations of climate suggest that the ocean sediments accumulated over tens of millions of years, and recent "ice ages" occurred over periods of time on the order of 100 millennia. These ages are not compatible with a literal interpretation of the biblical account of creation and earth history. The main sources of disagreement between the conventional model of earth history and a model consistent with the Bible for sediment accumulation are the assumptions about the magnitude of the driving mechanism and the process rates. The conventional model assumes sediment accumulated slowly over long periods of time by low-energy processes. The creation model, to be developed in this paper and with more supporting documentation in Vardiman (1995), assumes most of the thick sedimentary layer on top of the continental basement and underwater accumulated rapidly over a relatively short period of time by catastrophic processes during and following the global Flood described in Genesis.

Biblical Time Constraints

The Bible does not speak directly about sea-floor sediments or foraminifera. Nowhere do the scriptures describe the vast layers of sediment which cover the ocean floor, nor do they discuss the processes by which they were formed. Scripture contains only brief, general references that discuss the creation of the sea and God's control over its devastating power. Yet, it is evident that if a global Flood occurred as described in scripture, catastrophic events would have occurred in the ocean and massive quantities of sediments would

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have been produced and distributed over the continents and the ocean floor. Some sediments may have originated on the third day of the creation week when the continents were separated from the oceans, as described in Genesis 9, 10. However, it is likely that most of the sediments were produced during the Flood.

The Flood is described in Genesis 7 primarily in relation to the destruction of life upon the earth. God's concern centers around man. However, if ". . . every living substance was destroyed which was upon the face of the ground . . ." and ". . . all the high hills, that were under the whole heaven, were covered . . . ," it is logical to assume that major devastation to the crust of the earth occurred as well. The Scriptures do not address these effects, but if one accepts the biblical account that a global Flood occurred, then the geologic evidence over the earth bears silent testimony to the destructive power of the Flood event.

The conventional old-earth model assigns an age of about 65 million years B.P. to the end of the Cretaceous period. A literal interpretation of scripture would suggest that the origin of planet earth occurred quite recently—much less than 65 million years ago. The recent-creation model, which I will use, assumes God created the world in a supernatural creative event some 6,000 years ago, and judged His creation through a worldwide catastrophic Flood some 4,500 years ago. The assumption that the Flood occurred about 4,500 years ago is derived from Ussher (1786) using the Textus Receptus. Some would choose a longer chronology based on the Septuagint and relaxation of additional time constraints (Aardsma, 1993). However, the author prefers this time frame, at least to start the study. Between God's supernatural interventions in the affairs of the world, He normally allows the physical processes to operate according to the laws of science. We wish to determine whether the sea-floor sediment data can be reasonably explained within this conceptual framework.

Thickness of Sediments and Accumulation Rates

The occurrence of a global Flood, as described in the Bible, would have produced layers of sediment on both the continents and the sea floor. Many of these sediments would have been deposited rapidly during and immediately following the Flood. After the Flood, as the frequency and intensity of the tectonic events subsided (Wise et al., 1994), the rate of lithogenous sediment deposition would have decreased in proportion to the decrease in tectonic activity and in proportion to the reestablishment of vegetative cover. Because the oceans would have been well-mixed by the Flood and probably warmed somewhat by the energy released from frictional forces and heat from magma, brines, etc., brought up from deep within the earth associated with ". . . all the fountains of the great deep . . ." (Gen. 7:11), as well as volcanism, it is likely that biogenic sedimentation would have increased after the Flood for some time until the nutrients were depleted. As the nutrients were depleted and the ocean cooled and stratified, the biogenic sediments would have decreased with time.

The functional change in sediment formation after the Flood is unknown. However, it is reasonable to assume an exponential decrease in tectonic activity and, consequently, an exponential decrease in sediment formation. It is commonly found in geophysical phenomena that a sudden pulse in activity (earthquake frequency, volcanic activity, rate of erosion, sediment deposition, etc.) is often followed by an exponential decrease in intensity and / or frequency. An exponential function decreases by 63% over a given period called the relaxation time. For example, if the sea-floor sediment deposition rate was 100 cm / year at the end of the Genesis Flood and the relaxation time was 500 years, the deposition rate would be only 37 cm / year, 500 years after the Flood. One thousand years after the Flood the deposition rate would decline further to 14 cm / year, etc. The relaxation time is determined by the characteristics of the physical system and is generally defined as the time interval required for a system exposed to some discontinuous change of environment to undergo l / e (e = 2.718...) of the total change of state which it would exhibit after an infinitely long time. A refinement to the assumption of an exponential decrease in deposition may need to be made later by treating the accumulation of lithogenous and biogenous sediments separately. For now, a simple exponential decrease, irrespective of type, will be assumed.

The current accumulation rate for sediment formation in the deep ocean has been measured extensively. The rate appears to vary between about 1 cm / 1000 years to about 10 cm / 1000 years, depending on the investigator and location on the earth. The rate is so small that direct measurements are difficult. In addition, corrections must be made to account for dissolution and other effects. Traps are positioned at various levels in the ocean to collect samples of sediments as they drift downward from biogenous and lithogenous sources. For calibration purposes a uniform accumulation rate is assumed and the observations are compared with the upper layers of sediment formed over the past few hundred years. Since the conventional interpretation of sea-floor sediment accumulation requires at least tens of millions of years for the formation of the observed layers, it is likely that the average accumulation rates quoted are biased to small values. Nevertheless, the model developed here will assume today's average accumulation rate of deep sea-floor sediment is 2 cm / 1000 years or 2×10^{-5} meters / year.

The thickness of sea-floor sediment accumulated since the Flood is unknown. It is unclear how much of the sediment was formed during the energetic events of the Flood and how much formed later as the effects of the Flood subsided. There is no uniformity of opinion among creationists as to the location of the boundary between pre-Flood and Flood rocks on the continents, let alone between Flood and post-Flood strata on the ocean floor. For example, some creationist scientists believe the boundary between pre-Flood and Flood rocks in the Grand Canyon occurs between the Vishnu Schist / Zoroaster Granite and the Tapeats Sandstone at the Great Unconformity about 4,000 feet below the south rim. Others would include the tilted layers of Dox Sandstone, Shinumu Quartzite, Hakatai Shale, and Bass Limestone in the Flood sediments. Some would even include the metamorphosed Vishnu Schist and Zoroaster Granite as Flood layers. Morris (1976) indicates that the entire continental Tertiary Period was probably produced by the events of the Flood. If creationists cannot agree on the location of the boundaries between major events on the continents where there are numerous exposures to study, how much less likely is agreement on boundaries in sediments miles under the ocean?

For the purpose of this first study, the partition between the Flood and post-Flood events will be assumed to be at the Cretaceous/Tertiary boundary. This is one of the most recognizable boundaries in the geologic column. It is the boundary between two of the major eras—the Mesozoic and the Cenozoic. It has been identified by creationists and non-creationists alike as the location of major changes in geologic history. In fact, some evolutionists are now suggesting worldwide catastrophic events at the Cretaceous/Tertiary boundary—namely, the impact of asteroids on the earth, a worldwide dust cloud, global winter, and the destruction of the dinosaurs and many major life forms. Many of these scenarios fit well with the devastation suggested by creationists in the global Flood of Genesis.

In addition to this easily-recognizable boundary and the catastrophism associated with it, the temperatures inferred by the ^{18}O record show a decline to the present from a maximum during the Cretaceous Period. If the oceans were heated by events of the Flood, the Cretaceous Period would logically be included in the Flood. Several warm events occurred following the Cretaceous but these were of smaller magnitude, lending support to the idea of the Tertiary coming after the year of the Flood. Use of temperature estimates from δπωO of foraminifera should always be used with caution. Some of the data sources used in this study only reported a single value at intervals of 140 centimeters. The most precise data were at five centimeter intervals, but variances were not provided.

DSDP extracted cores from 624 sites on the ocean floors of the globe. Cores from most of these sites showed only recent sediments from the Tertiary and Quaternary periods. Of the 624 total sites only 186 contained sediments from the Cretaceous period or earlier. This means that the ocean floor is relatively young compared to the continents. The mean thickness of the sediments above the Cretaceous/Tertiary boundary (as identified by DSDP based on fossils, paleomagnetics stratigraphy, etc.) for all 186 sites was 322 meters, with a standard deviation of 273 meters. Figure 1 shows a histogram of sediment depth for the 186 sites. The mean thickness of the sediments reported below the Cretaceous/Tertiary boundary was about 400 meters in the Atlantic Ocean and 100 meters in the Pacific Ocean.

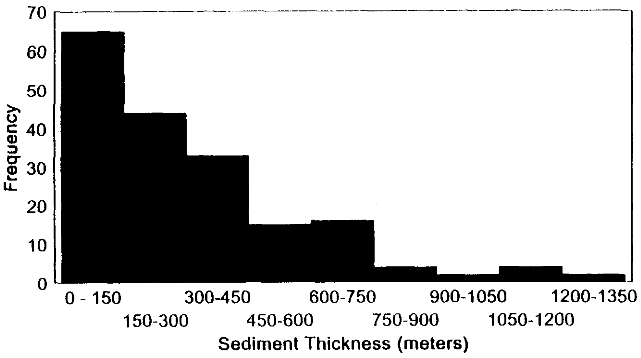

Figure 1. Frequency histogram of sediment thickness above the Cretaceous/Tertiary boundary for 186 cores from the DSDP.

A Young-Earth Age Model

The conventional age model used to calculate the age of sediment as a function of depth assumes that the accumulation rate of sediment was essentially constant over millions of years at today's rate of about 2 x 10^{-5} meters/year. If, in fact, the accumulation rate was much greater following the Flood and decreased exponentially until today, then the period of time back to the formation of a given layer can be found from the following sediment accumulation model.

Let the sediment accumulation rate be an exponentially decreasing function of time since the Flood:

$$\frac{dy}{dt} = A\,e^{-\frac{t}{\tau}} \qquad \text{Eq. 1}$$

where y represents the height of a sediment layer above a reference point (in this case the Cretaceous/Tertiary boundary), A is a constant to be determined from the boundary conditions, τ the relaxation time, and t is the time after the Flood when a layer of sediment was laid down. This equation can be integrated to give the height y directly:

$$y = -A\tau\,e^{-\frac{t}{\tau}} + C \qquad \text{Eq. 2}$$

where C represents a constant of integration to be determined from the boundary conditions. For the first boundary condition, $y = 0$ at $t = 0$. It is assumed in this model that initially no sediment had yet begun to accumulate, so:

$$y = 0 = -A\tau + C. \qquad \text{Eq. 3}$$

Solving for C and substituting into Eq. 2:

$$y = A\tau[1 - e^{-\frac{t}{\tau}}]. \qquad \text{Eq. 4}$$

For the second boundary condition, $y = H$ at $t = t_F$, where H represents the total depth of the sediment above the Cretaceous/Tertiary boundary and t_F is the time in years since the Flood. For this condition:

$$y(t = t_F) = H = A\tau[1 - e^{-\frac{t_F}{\tau}}]. \qquad \text{Eq. 5}$$

Solving for A:

$$A = \frac{H}{\tau[1 - e^{-\frac{t_F}{\tau}}]}. \qquad \text{Eq. 6}$$

Substituting back into Eq. 4:

$$y = \frac{H[e^{\frac{t}{\tau}} - 1]}{[e^{\frac{t}{\tau}} - \frac{e^{-\frac{t_F}{\tau}}}{e^{-\frac{t}{\tau}}}]}. \qquad \text{Eq. 7}$$

A more useful relationship may be found by inverting this equation to find t as a function of *y*, *H*, and τ.

$$t = -\tau \ln[1 - \frac{y}{H}(1 - e^{-\frac{t_F}{\tau}})]. \qquad \text{Eq. 8}$$

This relationship is typically called an age model and is used to find the age of a layer based on its vertical position. At this point, it is not specific to any particular worldview and can be applied to any chronology by substituting any time frame, t_F, between the Cretaceous/Tertiary boundary and today. When applying Eq. 8 to a specific site, the value of *H* for that site should be used, not the average sediment thickness discussed earlier.

If the chronology of the Biblical events according to Ussher (1786) is assumed to be true, approximately 4,500 years have transpired since the Flood (t_F = 4,500). Using this time interval, the average observed depth of sea-floor sediment above the Cretaceous/Tertiary boundary (322 meters), and the measured accumulation rate of sediment today (2 x 10^{-5}cm/year), the relaxation time, τ, may be determined from Eqs. 1 and 5.

Substituting the time interval since the Flood and today's sediment accumulation rate into Eq. 1:

$$\frac{dy}{dt}(t = 4500) = Ae^{-\frac{4500}{\tau}} = 2 \times 10^{-5}\ m/yr. \qquad \text{Eq. 9}$$

The initial sedimentation rate, A, in terms of the relaxation time, τ, may be found:

$$A = 2 \times 10^{-5} m/yr\ e^{\frac{4500}{\tau}}. \qquad \text{Eq. 10}$$

Substituting *A* into Eq. 5:

$$H = 2 \times 10^{-5}\ m/yr\ \tau[e^{\frac{4500}{\tau}} - 1]. \qquad \text{Eq. 11}$$

Rewriting in order to facilitate solving for:

$$\ln[1 + \frac{H}{2 \times 10^{-5}\tau}] = \frac{4500}{\tau}. \qquad \text{Eq. 12}$$

This is a transcendental equation in τ. The solution for τ can be found using iterative methods or by finding the point at which the two sides of the equation are satisfied jointly. The second method was used here by plotting the left and right sides of Eq. 12 simultaneously and solving for τ using the average value of *H*. The solution to this transcendental equation gives a value for τ of 373 years. Substituting τ = 373 years and t_F = 4,500 years into Eq. 8 results in the following young-earth age model, derived from young-earth boundary conditions:

This age model is displayed in Figure 2. The height of sea-floor sediment above the Cretaceous/Tertiary boundary, *y*, is shown on the vertical axis and time since the Flood, *t*, on the horizontal axis. The age model is shown for several total sediment depths, *H*. Note, that each curve asymptotically approaches the value of *H* as time approaches 4,500 years after the Flood. In general, it can be seen from Eq. 7 that *y* = 0 when *t* = 0 and *y* = H when *t* = t_F.

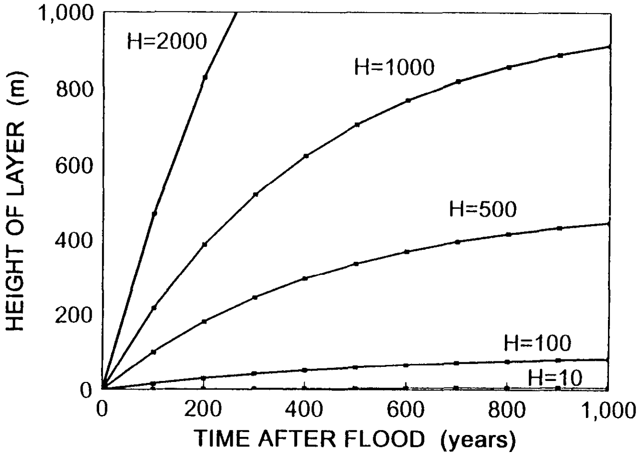

Figure 2. Age of sediment layer from the young-earth age model vs. height above the Cretaceous/Tertiary boundary and the total sediment thickness, H, in meters.

Application of a Young-Earth Age Model

The age model developed here can now be applied to data used by Kennett et al. (1977) to estimate ocean temperatures from the Cretaceous to the present. The analytical procedures and interpretations are contained in Shackleton and Kennett (1975). For this analysis the total sediment thickness *H* above the Cretaceous/Tertiary boundary was found to be 760 meters. Figure 3 shows the results of applying the new young-earth age model to these same data.

A significantly different interpretation of the data from that of Kennett et al. (1977) results. First, the period over which the data occur is assumed to be about 2000 years, rather than 65 million years. Second, the temperature initially decreases rapidly, followed by a slower decrease. The decrease shown by Kennett et al. (1977) is basically linear with a few short-period departures implying a gradual cooling over a long period of time. The trend shown in Figure 3 is typical of rapid cooling driven by a large temperature gradient. If the oceans were initially warm at the end of the Flood and were cooled to a new equilibrium temperature by radiation to space in the polar regions, this would be the type of cooling curve one would expect. The relaxation time appears to be about 1000.

This curve was derived from benthic foraminifera in the South Pacific at high latitudes, so polar ocean bottom waters show a dramatic cooling of about 20°C. Similar analyses of polar surface waters using planktic foraminifera show a similar cooling trend of about 20°C but averages that are slightly warmer. Equatorial surface waters show only a minor cooling of 5°C or so, while equatorial bottom temperatures show a similar cooling trend as polar waters of about 20°C. The initial

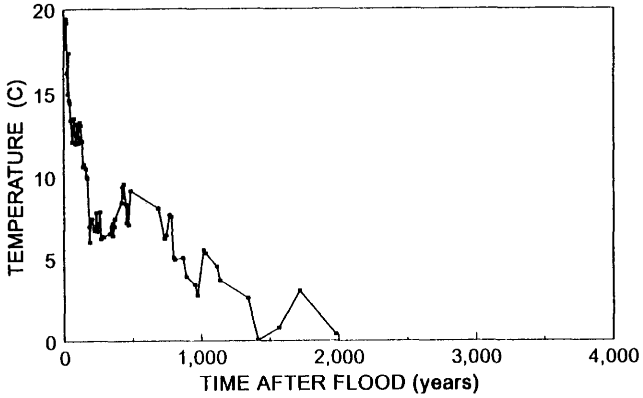

Figure 3. Polar ocean bottom temperature vs. time after the Flood. Data are from Kennett et al. (1977) composited from DSDP sites 277, 279, 281.

temperature for each of these cases was estimated to be about 20°C.

These results are interpreted as surface cooling of polar waters followed by sinking and movement toward the equator along the ocean floor. A general oceanic circulation is established where warm equatorial water is transported poleward at the surface and cold polar water is transported toward the equator at the ocean floor. Horizontal gyres within the separate ocean basins are superimposed on these latitudinal motions by the Coriolis force.

In the polar regions one would expect surface cooling to decrease the temperatures at the ocean floor because the cooler water aloft would sink and displace the warmer water below. This interchange would result in vigorous vertical mixing and cooling of bottom waters. During this strong cooling period one would predict outstanding conditions for nutrient supply and formation of biogenous sediments in the polar regions. In the tropics the ocean would have become more stratified with time because of the advection of cold bottom water under the warmer surface water. Except for specific regions of upwelling along the continents and near the equatorial countercurrents, vertical transport of nutrients and, therefore, the formation of biogenous sediments, would have been more restricted.

The data resolution in Figure 3 is very coarse. Near the top of the sediments sampling occurs at close intervals for the young-earth model because the sedimentation rate is decreasing exponentially. Fortunately, many cores have been extracted in recent years and sampled for $\delta^{18}O$ at very high resolution. This allows time to be resolved to short intervals near the top of the core. It is desirable that data be displayed over equal time intervals to avoid potential aliasing problems, however, this was not attempted in this study. Resampling would be required to avoid this problem which may even require additional chemical analyses.

Figure 4 shows the results of applying the new young-earth age model to a high-resolution core extracted from site RC11-120 in the Sub-Antarctic Pacific at about 45° S latitude. Note that a consistent warming trend of about 5°C has occurred in the recent past preceded by rapid fluctuations at various time scales. Rapid warming followed by a slow cooling trend occurred between 1500 and 2500 years after the Flood.

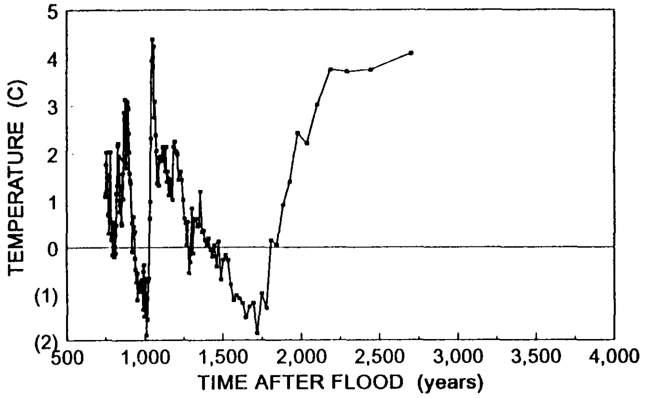

Figure 4. Polar ocean bottom temperature vs. time after the Flood. Data are from core RC11-120 use in the CLIMAP project.

The "ice age" in the young-earth chronology (Vardiman, 1993, 1994a, 1994b) would have ended about 2000 years ago. This event has been identified in the literature as the most recent "ice age" followed by rapid deglaciation. Note that the period of this event is on the order of 700 years for the young-earth model instead of the conventional 100,000 years.

If the "ice age" ended about 2000 years ago as suggested above, there should be evidences for recent dramatic changes in climate. Historical and archeological records between 0 and 2000 B.C. should reveal changes in ice cover on mountains and in polar regions, changes in sea level, and expanding deserts. Most conventional reports place the end of the "ice age" between 11,000 and 20,000 B.C. With the exception of a report by Hapgood (1966) which presents data on advanced civilizations during the "ice age," the author is unaware of evidences for such events between the time of Christ and Abraham. The Chronology earlier than about 1000 B.C. is based heavily on carbon dating techniques which are suspect if the Genesis Flood occurred only slightly earlier. The search for historical and archeological evidence for a recent "ice age" should be given high priority.

The young-earth age model has also been applied to a second high-resolution core taken from site V28-238 in the Pacific near the equator. The results, shown in Figure 5, also show a 5°C warming trend in the recent

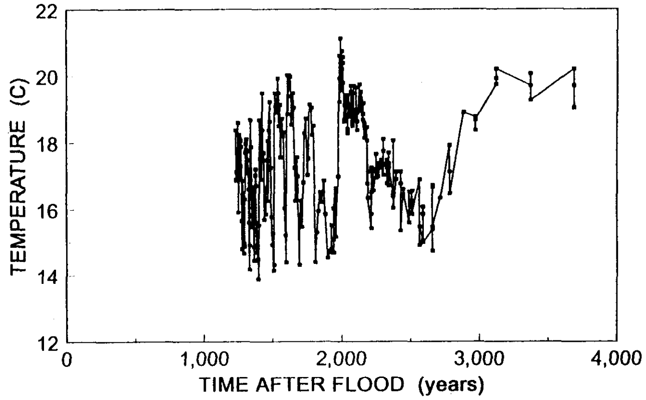

Figure 5. Equatorial Pacific Ocean surface temperature vs. time after the Flood. Data are from core V28-238 used in the CLIMAP project.

past preceded by similar oscillations in temperature. The period of the feature in this core associated with the most recent "ice age" is also about 700 years, but the temperature is about 15°C warmer. Because this core was longer than the previous one we can see a longer period of temperature oscillations into the past. Notice that these oscillations have a fairly uniform period of about 100 years. This compares to a period of about 20,000 years derived from the conventional model.

Implications of a Young-Earth Age Model

It has been recognized for several years that the layering of sediments on the ocean floor has been deposited in such a manner indicating that some type of harmonic process has occurred. Analysis of $\delta^{18}O$ in fine resolution cores show periodic repetitions of cold and warm periods. A statistical correlation between the temperature oscillations and the periods of the three orbital parameters of the earth/sun system has led to stronger support for the astronomical theory. CLIMAP and SPECMAP were two projects designed to strengthen this relationship.

A frequency analysis of many cores with the traditional age model found that peaks in the frequency spectra occurred at periods of approximately 20, 40, and 100 thousand years. Because these periods were similar to those of the orbital parameters, it has been assumed that the driving mechanism for the temperature fluctuations derived from sea-floor sediments is the change in radiational warming of the earth as the earth/sun distance and orientation change. These concepts have become known as the astronomical theory, a revision of a theory proposed by Milankovich (1930, 1941).

However, several difficulties have yet to be resolved with this theory. First, the magnitude of the change in radiational heating calculated from the orbital parameters does not seem to be large enough to explain the observed cooling and heating. Secondary feedback mechanisms have been proposed to amplify the orbital effects. However, it has been found that many of the hypothetical feedback mechanisms are of the wrong sign at certain phases of the orbital cycles.

A major result of this need for feedback mechanisms has been the development of a perspective that the earth's climate systems are extremely sensitive to minor disturbances. A relatively minor perturbation would initiate a non-linear response which could lead to another "ice age" or "greenhouse." Because of the fear of the consequences such a small perturbation might cause, radical environmental policies on the release of smoke, chemicals, and other pollutants and the cutting of trees have been imposed by some countries. If the basis for the astronomical theory is wrong, many of the more radical environmental efforts may be unjustified.

A second difficulty with the astronomical theory is the relative effect of the orbital parameters. The orbital parameter which has a period of about 100,000 years produces the weakest change in radiational heating. If the "ice ages" are caused by radiational changes, the orbital parameter causing them should be the largest of the three. Yet, the orbital parameter with the 100,000 year period is the smallest of the three.

If the young-earth age model proposed by this work is valid, the conventional correlation between sea-floor sediments and the orbital parameters is completely false. The periods illustrated in Figures 4 and 5 are on the order of 100 years and 700 years. Rather than an external forcing function like orbital parameters causing fluctuation in the earth's climate system, it is suggested that these oscillations are a manifestation of frequencies which are naturally present in the earth-atmosphere-ocean system. These natural frequencies were probably excited by the initial high-energy events of the Flood In the young-earth model there has been only enough time for one "ice age" since the Flood. The initial forcing function for the "ice age" was the tremendous amount of heat left in the oceans by the events of the Flood. The length of the "ice age" would have been determined by the amount of time for the oceans to lose their heat to the atmosphere and subsequently to space.

Many other shorter-period oscillations in the earth's climate system may still be operating, however. For example, a significant oscillating climate event which has received a large amount of international research attention recently is the El Nino/Southern Oscillation (ENSO) which has been documented in the equatorial Pacific (Jacobs et al., 1994). This climate event starts as a warming of surface waters in the western equatorial Pacific. It progresses eastward over a period of two to four years increasing precipitation along the equator and changing the wind patterns. When it intersects the Americas, it produces flooding and major changes in marine habitats along the west coasts of both continents. Effects further east cause wet and dry regions over large areas. This oscillation has a period of about seven years and may be just one example of many such oscillations still observable in our atmosphere/ocean system. If a young-earth model of sea-floor sediment accumulation such as that developed in this monograph can be justified, the conventional theories of multiple "ice ages," greenhouse warming, and millions of years of earth history required for evolutionary processes will be refuted.

Conclusions and Recommendations

An alternative, analytic, young-earth model of sea-floor sediment accumulation has been developed in this treatment. Rather than a slow accumulation of sediments at a nearly constant rate of a few centimeters per millennium over millions of years, an initially rapid accumulation of sediments decreasing exponentially to today's rate over some 4,500 years was assumed. Observations of $\delta^{18}O$ from sea-floor sediment cores were transformed to estimates of temperature and plotted as a function of time of deposition in accordance with this exponential model.

These plots indicate that temperature at the floor of tropical and polar oceans and the surface of polar oceans decreased rapidly, immediately following the estimated end of the Flood. This decrease was on the order of 15°C and asymptotically cooled to today's average value of 4°C. The major portion of the cooling occurred in about 1000 years, in agreement with Oard's (1990) estimates of cooling following the Flood. Application of this model to very detailed tropical cores found a consistent warming trend of about 5°C over the recent past, preceded by rapid fluctuations of temperature at various time scales. The period of the longer fluctuations, typically identified with the "ice ages," is on the order of 700 years, rather than the conventional 100,000 years. The period of the shorter fluctuations is about 100 years, compared to the conventional 20,000 years.

The major decrease in oceanic temperature by 15°C, following the Cretaceous Period, is suggested to be the cooling of the ocean to a lower equilibrium temperature following the Genesis Flood. The 100-year and 700-year fluctuations are suggested to be transient oscillations as the ocean / atmosphere system reached equilibrium.

Massive quantities of data available from DSDP ODP and other sea-floor core drilling projects may be used to investigate other features of sediment accumulation from a young-earth perspective. $\delta^{18}0$ is only one of many variables available or such studies. Cores from almost 1000 sites and nearly every region of the ocean floor are available for study. It is likely that an entirely new understanding of paleoceanography could be developed from this preliminary age model.

In order to improve the young-earth model proposed here, similar analyses should be made of $\delta^{18}O$ measurements for many additional cores. The results of Douglas and Savin (1971, 1973, 1975), Savin, Douglas, and Stehli (1975), and Shackleton and Kennett (1975) should be replicated with more recent cores over a wider geographic distribution. $\delta^{18}O$ observations from the upper 50 meters of sediment would be of particular interest. Further consideration should be given to the identification of the Flood / post-Flood boundary. It may be that the Cretaceous / Tertiary boundary is too deep in the geologic column. A larger survey of sediments above the Cretaceous / Tertiary boundary may lead to smaller values for a typical thickness, reducing the model accumulation rate and revising other parameters in the young-earth model. A universal average sediment thickness should not be used to plot time versus depth at any single site.

An analysis of the productivity of biogenous sediments in the post-Flood ocean should be made and compared with the mass of sediments observed. The accumulation of hundreds of meters of sediment, on the average, and kilometers of sediment in some locations, such as the Arctic Ocean, require very high productivity following the Flood. Although the potential for high productivity has been suggested by Roth (1985), can the oceans supply enough nutrients, in some 4,500 years, to explain the observed sediments?

Refinements in the young-earth model should be made to better simulate the formation of sediments. Such assumptions as the exponential decrease in accumulation, the total depth of post-Flood sediments, and the composite of biogenous and lithogenous sediments should be explored further. The model may need separate parameters for different oceans, latitudes, and sediment types, as well as sites.

A similar study should be conducted for δ^{13} C. $\delta^{18}0$ was selected for this first study because of its immediate relationship to climate and the polar ice sheets. However, the burial of carbon has major implications on the mass balance of carbon in the hydrosphere, biosphere, and atmosphere. It affects the formation of carbonates, the radiation balance and temperature of earth, and paleochronometers such as ^{14}C. Combinations of $\delta^{18}O$ and δ^{13} C may be useful for estimating productivity and sediment accumulation rates.

The result of this effort was to initiate the development of an analytical model of sea-floor sediment accumulation. The model uses the measured sediment accumulation rate of today, the observed sediment depth on the ocean floor, and a literal Biblical time frame as boundary conditions. An exponentially-decreasing accumulation function was assumed. All of the questions have not been answered. In fact, this monograph may raise more questions than it answers. Other researchers are encouraged to work on portions of this problem and to keep me informed.

Acknowledgments

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References

Aardsma, G. E. 1993. Radiocarbon and the Genesis Flood. Institute for Creation Research Monograph. San Diego, CA.

Austin, S. A. and K. P. Wise. 1994. The pre-Flood / Flood boundary as defined in Grand Canyon, Arizona and eastern Mojave Desert, Arizona. In Walsh, R. E., editor, Proceedings of the Third International Conference on Creationism, Creation Science Fellowship. Pittsburgh, PA. pp. 37-47.

Douglas, R. G. and S. M. Savin. 1971. Isotopic analyses of planktonic foraminifera from the Cenozoic of the Northwestern Pacific, Leg 6. In Fisher. A. G., B. C. Heezen. R. E. Boyce, D. Bukry, R. G. Douglas, R. E. Garrison, S. A. Kling, V. Krasheninnikov, A. P. Lisitzen, and A. C. Pimm, Initial Reports of the Deep Sea Drilling Project. 6:1123-1127. GPO. Washington, D.C.

Douglas, R. G. and S. M. Savin. 1973. Oxygen and carbon isotope analyses of Cretaceous and Tertiary foraminifera from the Central North Pacific. In Roth, P. H. and J. R. Herring, editors, Initial Reports of the Deep Sea Drilling Project 17:591-605. GPO. Washington, D.C.

Douglas, R. G. and S. M. Savin. 1975. Oxygen and carbon isotope analyses of Tertiary and Cretaceous microfossils from Shatsky Rise and other sites in the North Pacific Ocean. In Gardner, J. V., editor, Initial Reports of the Deep Sea Drilling Project. 32:509-520. GPO. Washington, D.C.

Hapgood, C. H. 1966. Maps of the sea kings: Evidence of advanced civilizations in the ice age, First Edition. Chilton Books. Philadelphia, PA..

Jacobs, G. A., H. E. Hurlburt, J. C. Kindle, E. J. Metzger, J. L. Mitchell, W. J. Teague, and A. J. Wallcraft. 1994. Decade-scale trans-Pacific propagation and warming effects of an El Nino anomaly. *Nature* 370:360-363.

Kennett, J. P., R. E. Houtz, P. B. Andrews, A. R. Edwards, V. A. Gostin, M. Hajis, M. Hampton, D. G. Jenkins, S. V. Margolis, A. T. Ovenshine, K. Perch-Nielsen. 1977. Descriptions of procedures and data for sites 277, 279, 281 by the shipboard party. In Initial Reports of the Deep Sea Drilling Project 29:45-58, 191-202, and 271-285. GPO. Washington, D.C.

Milankovitch, M. 1930. Mathematische klimalehre und astronomische theorie der klimaschwankungen. In Köppen, I. W. and R. Geiger, editors, Handbuch der Klimatologie. Gebruder Borntraeger. Berlin, Germany.

Milankovitch, M. 1941. Canon of insolation and the ice age problem (in Yugoslavian). Serbian Academy Beorg., Special Publication 132. English translation in 1969 by Israel Program for Scientific Translations. Jerusalem, Israel.

Morris, H. M. 1976. The Genesis record. Baker Book House. Grand Rapids, MI. Creation-Life Publishers. San Diego, CA.

Oard, M. J. 1990. An ice age caused by the Genesis Flood. Institute for Creation Research Monograph. San Diego, CA.

Roth, A. A. 1985. Are millions of years required to produce biogenic sediments in the deep ocean? *Origins* 5:48-56.

Savin, S. M., R. G. Douglas, F. G. Stehli. 1975. Tertiary marine paleotemperatures. *Geological Society of America Bulletin* 86: 1499-1510.

Shackleton, J. J. and J. P Kennett. 1975. Paleotemperature history of the Cenozoic and the initiation of Antarctic glaciation: Oxygen and carbon isotope analyses in DSDP sites 277, 279, 281. In Initial Reports of the Deep Sea Drilling Project 29:743-755. GPO. Washington. D.C.

Ussher, J. 1786. The Annals of the world. Printed by E. Tyler for J. Crook and G. Bedell. London. England.

Vardiman, L. 1993. Ice cores and the age of the earth. Institute for Creation Research Monograph. San Diego, CA.

Vardiman, L. 1994a. An analytic young-earth flow model of ice sheet formation during the "ice age." In Walsh, R. E., editor, Proceedings of the Third International Conference on Creationism. Creation Science Fellowship. Pittsburgh, PA. pp. 561-568.

Vardiman, L. 1994b. A conceptual transition model of the atmospheric global circulation following the Genesis Flood. In Walsh, R. E., editor, Proceedings of the Third International Conference on Creationism. Creation Science Fellowship. Pittsburgh, PA. pp. 569-579.

Vardiman, L. 1995. Sea-floor sediment and the age of the earth. Institute for Creation Research Monograph. San Diego, CA.

Wise, K. P., S. A. Austin, J. R. Baumgardner, R. D. Humphreys, A. A. Snelling, and L. Vardiman. 1994. Catastrophic plate tectonics: A global flood model of earth history. In Walsh, R. E., editor, Proceedings of the Third International Conference on Creationism. Creation Science Fellowship. Pittsburgh, PA. pp. 609-621.

PANORAMA NOTE

Quarterly Review-Volume 25

Introduction

The *Creation Research Society Quarterly* has been published since 1964 (32 complete volumes). In an effort to make these volumes available, all of the missing issues have been reprinted. Brief synopses have been written on volumes l-24 and have appeared in the previous 24 Quarterlies. In each synopsis, major articles are reviewed to give a person interested in scientific creationism a general idea of the contents of that volume. Many of the articles are of continuing interest and value. Several differences of opinion on particular scientific topics appeared in many of the articles, notes and letters in this volume.

Philosophy and History

A review of the triumph of the philosophy of naturalism in American intellectual circles was given by Carson (1988, pp. 16-24). The relationship of the philosophy of progress and the theories of evolution was discussed. A critique of Darwinian evolution was offered and the effects of evolutionary doctrine on American society was noted. Another Quarterly selection was used to show the defects of naturalistic philosophy and to discuss its brutalizing effects on humanity (Roche, 1988b, pp. 125-126). Wise and Frair (1988, pp. 83-84) wrote an interesting note on their observations of a National Center for Science Education meeting.

John Klotz (1988, pp. 27-28), in an essay with a provocative title, "Can Fifty Million Frenchmen Be Wrong?," explained that scientists can be wrong in adopting an evolutionary viewpoint. The differences in origin science and operation science are discussed in a book review (Boylan, 1988, pp. 48-49). An exchange on materialistic and non-materialistic hypotheses and their relationship to a proper philosophy of science was presented (Allen, 1988, pp. 55-57; Riemen, 1988, pp. 57-58). Roche (1988a, p. 82) illustrated the danger of replacing creationism with "self-created" man.

Frances Bacon's philosophy of science was briefly examined in a book review (McGhee, 1988a, p. 96). An exchange on the metaphysics of modern science was conducted by Kofhal (1988 pp. 102-103) and McGhee (1988b, pp. 103-104). Randomness and order were viewed from a biblical perspective (McGhee, 1988c, pp. 150 151). Williams (1989b, p. 183) explored creationist and evolutionist philosophies using the seed dispersal system of a plant, bush balsam.

Anthropology

A creationist evaluation of *Australopithecus afarensis* was conducted by DuBois (1988, pp. 65-69). He pointed out defects in the reasoning of anticreationists on the subject. Wayne Frair (1988, pp. 151-153) examined the relationship of australopithecines to man and concluded that there was none.

Biology

Evolutionary Studies

Darwinism as a myth was studied in a revealing book review by Rusch (1988b, pp. 97-99). The recapitulation theory was briefly discussed in an article review (Lammerts, 1988b, pp. 147-148). A thoughtful note by Richard Culp (1988b, pp. 100-103) exposed the many defects in the "ontogeny recapitulates phylogeny" proofs for evolution. Discussed were the protozoan, segmented worm, fish, hair and tail "stages."

Darwinianism, Neo-Darwinism and the postulated evidence for macroevolution was extensively covered by Wendell Bird (1988a, pp. 28-35; 1988b, pp. 74-81). Topics included were:

Paleontology: Gaps and Abrupt Appearance
Phylogenetic Trees
Organism Classification
Comparative Anatomy
Comparative Embryology
Comparative Biochemistry
Artificial Selection

von Fange (1989, pp. 184-190) presented an excellent history of the supposed evolution of the horse and noted ". . . the strange and wonderful contortions of taxonomists to remain mindlessly loyal when the theory of evolution fails them" (p. 184).

Geographical Distribution of Plants and Animals

Two different views of this topic were presented in this volume of the Quarterly. Culp (1988a, pp. 24-27) offered several examples of organisms that are similar but separated by great distance. Walter Lammerts (1988a, pp. 126-128) discussed disjunct populations of mammals and plants from another perspective. Both notes contain some interesting creationist interpretations.

Botany

Johnson (1989, p. 201) was willing to share some seeds of three-catyledon tomato plants with creationists for possible experimentation.

Zoology

Employing science and Scripture, Kaufmann (1988, pp. 69-72) demonstrated the fallacies of feminist thought. This anti-Christian, humanist movement has destroyed many of its devotees, causing many unnecessary problems in our society. Mehlert (1988b, pp. 99-100) claimed that the Class Reptilia does not exist and he suggested:

> . . . that creation scientists consider the uniqueness and separateness of the various sub-groups at present lumped together under Class Reptilia and forget the alleged evolutionary relationships altogether (p. 100).

Hamilton (1988, pp. 117-120) continued his series of papers illustrating the impossibility that the eyes of various organisms could have evolved. In this selection he explained how the eyes of air-breathing vertebrates could not have evolved from sea dwelling creatures. In discussing spider webs, Williams (1988c, pp. 123-124) noted that this amazing engineering ability did not evolve by either convergence or parallelism. This is a "tool" designed specifically for certain organisms by a Creator.

Often one hears that predators kill the weak prey in a population. Contrary to this mythology, Williams and Meyer (1988, p. 128) gave an example of a mountain lion in Texas that killed three healthy does in an area while leaving a crippled doe alone. The crippled doe died later of natural causes and was never eaten by any predator. This theme has appeared in the Quarterly previously (Smith, 1976, pp. 79-81).

Paleontology

Mehlert (1988a, pp. 7-15) continued his attack on anticreationist criticisms of creationist writings. The alleged reptile to mammal transition is covered in this article. A brief quote from his abstract is instructive.

> For many years evolutionists have claimed that of all major groups of plants and animals, the fossil record of the origin of Class Mammalia is easily the best . . . However it will be shown that the case for the reptile to mammal transformation is extremely shaky and is based largely on inference, supposition and wishful thinking (p. 7).

Two notes (Calais and Williams, 1989, p. 181; Williams, 1989a, pp. 181-182) gave evidence of rapid, catastrophic burial of fish in the fossil record. Calais prepared excellent drawings of fish in the process of devouring smaller fish at the moment they were buried in sediment. Andrew Snelling discussed fish fossils located within Hawkesburg Sandstone in Australia that had to be buried quickly. Rapid burial of living organisms likely was accomplished during the Flood. Ronald Calais (1989, pp. 202-207) defended his contentions that "Protoavis" was actually a bird, not a transitional form against the protestations of Padian (1989, pp. 201-202). Calais also employed ichnological evidence in his answer.

Geology

Preliminary discussions on the origin of Santa Elena Canyon in Big Bend National Park were included in this volume (Rusch, 1988a, pp. 50-52; Williams, 1988a, pp. 52-54). A complete progress report on creationist speculations for the formation of this beautiful canyon was recently published (Williams and Howe, 1996). Rusch (1988c, pp. 108-110) offered some origin speculations on Dog Canyon in Big Bend National Park. This unusual canyon is quite interesting, geologically speaking. Cox (1988, pp. 54-55) related missing mineral inclusions in quartz sand grains to his model of rock formation. Rapid growth of stalactites in caves was again noted (Williams, 1988b, pp. 81-82). The cover of the September 1988 issue contained photographs of speleothems from New Fern Cave in Alabama.

Certain views on orogeny by astral catastrophism were called into question in an exchange (Northrup, 1988, pp. 104-106; Patten, 1988, pp. 106-108). In a study of the Mississippi River delta complex, it was surmised that the river was thousands, not millions of years old (Mehlert, 1988c, pp. 121-124). A recent examination of the Atchafalaya River Delta [within the Mississippi River delta complex] led to the same conclusion (Williams, in press). Wind-blown ripples in sand were shown in a brief note and a possible research project was suggested (Williams, 1988d, pp. 124-125). Russell Humphreys (1988b, pp. 130-137) proposed a Flood-related mechanism that could have caused the apparent reversals in the direction of the earth's magnetic field as recorded in igneous rocks. Tom Barnes (1989, pp. 170-171) presented a different view on the subject.

Age of the Earth, Solar System

Robert Gentry (1989, pp. 176-180) and Kurt Wise (1989, pp. 171-176) discussed the pros and cons of employing radioactive halos in rocks as evidence for a young earth. Gentry provided a model based on biblical and scientific evidence within which polonium halos could be interpreted. This exchange will be of interest to many creationists. Pluto's orbit was used as an example of why the solar system may be young by Oard (1989, pp. 182-183).

Physics

An extensive symposium on the speed of light (constant or variable?) was included in several issues. Some of the authors were in favor of the concept that the speed of light had decreased in the past, whereas other writers were opposed to the concept. Likewise other issues were covered in the symposium. Setterfield (1989, pp. 190-197) defended his work on a decreasing speed of light. Bowden (1989, pp. 207-208) agreed with Setterfield. Aardsma (1988, pp. 36-40; 1989, pp. 208-209); Humphreys (1988a, pp. 40-45); Holt (1988, pp. 84-88); Brown (1988, pp. 91-95) opposed the idea. The special theory of relativity and its implications were examined by Dudley Benton (1988, pp. 88-90). Byl (1988, pp. 138-140) developed a curved-pace model for the universe to account for the travel of light throughout space in a short period of time. The evidence for an expanding universe was called into question by Ettari in Part I 1988, pp. 140-146) of his series. This entire symposium makes for interesting reading on a wide variety of topics.

An article review on the origin of the moon illustrates the bankruptcy of naturalistic thinking on the subject (Chaffin, 1988, p. 46). Only a direct act by the Creator can account for its origin. Steidl (1988, pp. 95-96) noted the implications of the presence of hot gases in the universe. DeYoung (1988, p. 153) combined science and scriptural information in a discussion of the metal, gold.

Creationist Research

Duane Gish (1989, pp. 161-170) reviewed some of the creationist research efforts in the 14 years before 1989. Field studies on overthrusting, charcoalified wood, Thornton Quarry deposits, interbedding of certain strata within the Grand Canyon and the elliptical formation of the Tendurek Mountains of Turkey were outlined. The field and laboratory work involved in isolating pollen grains found in the Hakatai Shale, Hermit Shale and Supai Group, the rapid formation of speleothems and brine mixing experiments were reviewed. This volume of the Quarterly contained considerable information on the advances in scientific creationism.

References

CRSQ — Creation Research Society Quarterly.

Aardsma, G. E. 1988. Has the speed of light decayed recently?— Paper I. CRSQ 25:36-39.

——— 1989. Response to Bowden. *CRSQ* 25:208-209.

Allen. G. F. W. 1988. Philosonhy of science? *CRSQ* 25:55-57.

Barnes, T. G. 1989. Dwindling resource evidence of a young earth. *CRSQ* 25:170-171.

Benton, D. J. 1988. The special theory of relativity: Its assumptions and implications. *CRSQ* 25:88-90.

Bird, W. R. 1988a. The postulated evidence for macroevolution and Darwinism: Darwinian arguments and the disintegrating Neo-Darwinian synthesis (Part I). *CRSQ* 25:28-35.

——— 1988b. The postulated evidence for macroevolution and Darwinianism; Darwinian arguments and the disintegrating Neo-Darwinian synthesis — Part II. *CRSQ* 25:74-81.

Bowden, M. 1989. The speed of light — a critique of Aardsma's statistical method. CRSQ 25:207-208.

Boylan, D. R. 1988. Book review of *Origin science:* A *proposal for the creation-evolution controversy. CRSQ* 25:48-49.

Brown, R. H. 1988. Statistical analysis of *The atomic constants, light and time. CRSQ* 25:91-95.

Byl, J. 1988. On small curved-space models of the universe. *CRSQ* 25:138-140.

Calais, R. C. 1989. Response to Padian. *CRSQ* 25:202-207.

——— and E. L. Williams. 1989. Examples of rapid burial necessary for fossilization. *CRSQ* 25:181.

Carson, C. B. 1988. Naturalistic outlook. *CRSQ* 25:16-24.

Chaffin, E. F. 1988. Article review of "The origin of the moon." *CRSQ* 25:46.

Cox, D. E. 1988. Missing mineral inclusions in quartz sand grains. *CRSQ* 25:54.

Culp, G. R. 1988a. The geographical distribution of animals and plants. *CRSQ* 25:24-27.

——— 1988b. Embryology — overlooked facts you should know. *CRSQ* 25:100-102.

DeYoung, D. B. 1988. A golden mystery. *CRSQ* 25:153.

DuBois, P. 1988. Creationist evaluation of *Australopithecus afarensis. CRSQ* 25:65-69.

Ettari, V. A. 1988. Critical thoughts and conjectures concerning the Doppler effect and the concept of an expanding universe — Part I. *CRSQ* 25:140-146.

Frair, W. 1988. Australopithecines: Relationship to man? *CRSQ* 25:151-153.

Gentry, R. V. 1989. Response to Wise. *CRSQ* 25:176-180.

Gish, D. T. 1989. More creationist research (14 years) — Part I: Geological research. *CRSQ* 25:161-170.

Hamilton, H. S. 1988. The eye of the air-breathing vertebrate: Did it emerge from the sea? *CRSQ* 25:117-120.

Holt, R. D. 1988. The speed of light and pulsars. *CRSQ* 25:34-88.

Humphreys, D. R. 1988a. Has the speed of light decayed recently? Paper 2. *CRSQ* 25:40-45.

——— 1988b. Has the earth's magnetic field ever flipped? *CRSQ* 25:130:137.

Johnson, L. T. 1989. Seeds available for experiment. *CRSQ* 25:201.

Kaufmann, D. A. 1988. Femininism, humanism and evolution. *CRSQ* 25:69-72.

Klotz, J. W. 1988. Can fifty million Frenchmen be wrong? *CRSQ* 25:27-28.

Kofahl, R. E. 1988. Reply to "The metaphysics of modern science." *CRSQ* 25:102-103.

Lammerts, W. E. 1988a. Concerning disjunct populations of mammals and plants. *CRSQ* 25:126-128.

——— 1988b. Article review of "Ontogeny and phylogeny recapitulated." *CRSQ* 25:147-148.

McGhee, L. A. 1988a. Book review of *Francis Bacon's philosophy of science. CRSQ* 25:96.

———. 1988b. Response to Kofahl. *CRSQ* 25:103-104.

——— 1988c. Meditations on order and disorder. *CRSQ* 25:150-151.

Mehlert, A. W. 1988a. A critique of the alleged reptile to mammal transition. *CRSQ* 25:7-15.

———. 1988b. Reptiles and taxonomy. *CRSQ* 25:99-100.

——— 1988c. Another look at the age and history of the Mississippi River. *CRSQ* 25:121-123.

Northrup, B. E. 1988. A comment on Patten's views. *CRSQ* 25:104-106.

Oard, M. J. 1989. The solar system may be young after all. *CRSQ* 25:182-183.

Padian, K. 1989. "Protoavis"? *CRSQ* 25:201-202.

Patten, D. W. 1988. Response to Northrup. *CRSQ* 25:106-108.

Riemen, W. P. 1988. Reply to Allen. *CRSQ* 25:57-58.

Roche, G. 1988a. Replacing creationism with "self-created" man. *CRSQ* 25:82.

———. 1988b. Naturalism. *CRSQ* 25:125-126.

Rusch, Sr., W. H. 1988a. The big bend of the Rio Grande. *CRSQ* 25:50-52.

——— 1988b. Book review of *Darwinism: The refutation of a myth. CRSQ* 25:97-99.

——— 1988c. Dog Canyon, Big Bend National Park. *CRSQ* 25:108-110.

Setterfield, B. 1989. The atomic constants in light of criticism. *CRSQ* 25:190-197.

Smith, E. N. 1976. Prey-predator relationship. *CRSQ* 13:79-81.

Steidl, P. M. 1988. Article review of "Hot gas in the universe." *CRSQ* 25:95-96.

von Fange, E. A. 1989. The Litopterna — A lesson in taxonomy: The strange story of the South American 'false' horses. *CRSQ* 25:184-190.

Williams, E. L. 1988a. Santa Elena Canyon — 1986. *CRSQ* 25:52-54.

——— 1988b. Formation and rate of growth of stalactites. *CRSQ* 25:81-82.

——— 1988c. Spider webs. *CRSQ* 25:123-124.

———. 1988d. Wind-blown ripples in sand. *CRSQ* 25:124-125.

——— 1989a. Rapid burial and fossilization — Australian style. *CRSQ* 25:181-182.

——— 1989b. Seed pods: Creation or evolution philosophy. *CRSQ* 25:183.

——— 1996. Rapid delta formation — coastal Louisiana. *CRSQ* 33:178-182.

——— and G. F. Howe. 1996. The formation of Santa Elena Canyon, Big Bend National Park: Origin speculations. *CRSQ* 33:89-96.

——— and J. R. Meyer. 1988. Prey-predator relationship. *CRSQ* 25:128.

Wise. K. P. 1989. Radioactive halos: Geological concerns. *CRSQ* 25:171-176.

——— and W. Frair 1988. NCSE meeting. *CRSQ* 25:33-84.

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CREATION RESEARCH SOCIETY, A UNIQUE SCIENTIFIC SOCIETY LAB DIRECTOR'S REPORT

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The Psalmist said, "My help cometh from the Lord who made heaven and earth" (Psalm 121:2). What better qualification could we desire in seeking a helper! The Lord provides help in many different forms. Often He helps us through other people. Such is certainly the case with the history of the Creation Research Society. Down through the years many dozens of people have selflessly contributed untold hours of work and many thousands of dollars to the formation and development of one of the truly unique scientific organizations in the world.

I started to face the evolutionary challenges of graduate school in the Department of Zoology at the University of Iowa in 1963. At that time there was only a tiny handful of creationist material available. Today, a graduate student facing similar challenges has the help of more than 130 issues of the *Creation Research Society Quarterly* from which to draw information on a creationist evaluation of almost every discipline.

As we face the end of this millennium that help is being expanded through very significant giving on the part of many members. Your interest in including the Society in wills and trusts has increased as we have made more information and help available through professionally written financial brochures.

Usually, family members, close friends, and charitable organizations are included in wills and trusts. When you place the Creation Research Society in your last testament, you elevate the Society to the status of a close friend or family member. We do not take this honor lightly. We recognize this is a position earned by long-term mutual commitment and trust.

When you consider your will or trust, please note the following strengths of your Society:

1. We have completed more than 33 years of research and publication. This has provided a solid foundation for future work and growth and represents many hundreds of original research papers in the field of creation science.
2. Our recently-built, 3,000 square feet facility at the Van Andel Creation Research Center is providing us the capability of sophisticated field and laboratory research. Five acres of land here guarantees room for future expansion of additional buildings such as a publications' center and a research-grade greenhouse.
3. Debt-free operation has been a conservative strategy which has ensured that our entire financial history has been on the black side of the ledger. Thus, we have never had to resort to debt financing and no member has ever received a panic fund-raising letter from us.
4. All board members have outstanding academic qualification and have produced major research papers for the *Quarterly*. Most board members have earned doctorates in technical specialties and many have held significant positions in major universities, industry, or private research centers.
5. We have a rapidly-developing capability in providing assistance in wills, trusts, and other planned giving programs. Please feel free to write or call for help and information.
6. Member scientists now number more than 600 worldwide. They are committed to the highest level of technical research standards. It is encouraging to see our work taking on an international character.
7. Our editors have a long history of rigorous peer review of all technical papers. Historically, nearly 50 percent of all papers have been rejected and many others have undergone significant revision. No technical writer is exempted from this important peer review process.
8. Your *Creation Research Society Quarterly* is recognized, even by evolutionists, as one of the world's foremost creation journals. Last year, hundreds of back issues of the *Quarterly* were shipped to more than 20 foreign countries.
9. The Creator has blessed us with a growing endowment which helps insure financial stability and can act as a shock absorber in serious economic times. This "money that will never be spent" provides the principle from which interest and dividends are called upon to fund some of the work of the Society.
10. Each year our board and other members give thousands of hours of volunteer work in research, review, and publication of our *Quarterly* and the *Creation Matters* newsletter.
11. More than 150 people participate on our CRS NET on the Internet. Up to 50 postings per day have been recorded. Scientists and non-scientists alike meet here daily in Cyberspace to discuss the implications of recent scientific discoveries, to search for information in ongoing debates with evolutionists, and to provide mutual encouragement and help.

With this kind of track record we believe we have earned your respect and support. May the Lord bless our work as we labor together to glorify our Creator from Whom our help comes!

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Quote: Einstein on God and Order

When, in the 1930s the celebrated actress Elizabeth Bergner asked Einstein whether he believed in God, he replied: 'One may not ask that of someone who with growing amazement attempts to explore and understand the authoritative order in the universe.' When she asked, 'Why not.' he answered: 'Because he would probably break down when faced with such a question' (p. 37).

Pais, Abraham. 1994. Einstein lived here. Clarendon Press. New York.

AN INTRODUCTION TO MODERN UNIFORMITARIAN AND CATASTROPHIC PLATE TECTONIC CONCEPTS

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Abstract

Within the last 35 years, a revolution in geology has occurred through the advent, acceptance, and application of the unifying geodynamic theory of plate tectonics. Acceptance of plate tectonics followed the development of post-World War II geophysical datasets. The concept has proven popular both in and out of the geologic profession, as evidenced by its ubiquitous presence in earth science teaching at all levels, and its presentation in popular media. Plate tectonic interpretations are not restricted to uniformitarian geology. Recent publications advocate derivative catastrophist interpretations of plate tectonics.

Catastrophist and uniformitarian interpretations share many premises and conclusions. Therefore a concise analysis of more voluminous evidence for and against uniformitarian plate tectonics can be used as a shortcut to assess the credibility of catastrophic plate tectonics. Ongoing questions regarding uniformitarian plate tectonics offer reasons for skepticism of catastrophic plate tectonics until a more thorough evaluation is complete.

Introduction

A history of late twentieth century geology would undoubtedly revolve around the dramatic changes in the structure, technology and scope of the discipline, and could perceptively marvel at the flexibility of naturalistic uniformitarianism to accommodate all of these changes while maintaining its cornerstone status in the science. Although some interpret the developments of the twentieth century as the replacement of traditional geology by the new "earth sciences" (Wood, 1985), the continued dominant presence of naturalistic uniformitarianism demonstrates no fundamental philosophic change. Externally the ubiquitous presence of geology in frontiers such as marine studies and space exploration demonstrates an expanded application of geologic knowledge far beyond the bounds of the early twentieth century discipline. Internally, the shift from chronostratigraphic to environmental interpretation in stratigraphy; the advent of sequence and event stratigraphy; and the acceptance of modern plate tectonic theory have all made relatively smooth transitions from "outside" revolutions to conventional wisdom within the fundamental tenets of naturalistic uniformitarianism.

Plate tectonics (or the new global tectonics) has proven remarkably popular both in and out of the geologic profession, as is evidenced by its ubiquitous presence in earth science teaching at all levels (Lowman, 1992), and by its presentation in popular media such as *National Geographic* and *Public Broadcasting System* specials. The historical development of plate tectonics, both early and modern, has been documented and reviewed (Glen, 1982; Wood, 1985; Menard, 1986; Cone, 1991). A future contribution is being developed by the authors to review the historical development of plate tectonics, and a very brief summary is presented below.

Development of Plate Tectonics

Early expression of plate tectonic concepts is credited as far back as Francis Bacon (1561-1626), who noticed the conformity between the mapped coastlines of South America and Africa (Faul and Faul, 1983). The nineteenth century saw proposals of historical continental separation from both uniformitarian and catastrophist perspectives, but most historians consider Alfred Wegener (1880-1930) to be the progenitor of modern plate tectonics. Wegener explored a variety of evidence to support his contention that the continents were united in the Carboniferous into a supercontinent which he named Pangea. Wegener's work was rejected by the vast majority of his contemporaries but those that did accept his views (e.g., Dutch geologist Alexander du Toit) maintained an active minority viewpoint through the mid-twentieth century.

Modern plate tectonics developments are commonly attributed to studies of remanent magnetism in rocks and post-war sea-floor studies (Ewing and Ewing, 1959; Heezen, 1962; Shepard, 1963). Studies of remanent magnetism and the Earth's magnetic field suggested that either the magnetic pole or the continents had moved historically (Wood, 1985, pp. 113-116). Sea floor mapping showed the presence of extensive submarine orogenic belts (midocean ridges) and deep linear troughs. Harry Hess (1962), of Princeton University proposed the generation of new oceanic crust at the midocean ridges which migrated laterally away from the ridges over time. The term "sea-floor spreading" was introduced by Dietz (1961), and evidence for sea-floor spreading was presented by Vine and Matthews' (1963) description of symmetric magnetic anomalies

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on both sides of the midocean ridge in the North Atlantic Ocean. By the late 1960's the framework of modern plate tectonics had been published, and its application to numerous geologic phenomena such as orogenesis (Dewey and Bird, 1970) was quickly established. By the late 1970s most geologists accepted and applied plate tectonics to their work. Direct application was commonly limited to academic and industry research functions, since plate tectonic concepts are seldom predictive on the ordinary scale of employee projects.

In order to understand the impact of the new global tectonics on geological thinking, it is important to consider the explanatory value of the concept and the new datasets that demanded explanation. The history of the acceptance of plate tectonics is usually traced from the early ideas of Wegener which included (1) coastline matches of continents across oceans, (2) matching orogenic belts (3) paleontological correlations across oceans. These data were not convincing to Wegener's peers. Convincing the geologic profession of the validity of continental drift required not only the identification of anomalies in existing datasets, but also the discovery of new datasets supportive of the concept. Emphasis was placed on new datasets because they stimulated interest through their novelty, and did not have a preassigned evidentiary value based on the existing paradigm (although it might be argued that the conceptual framework of continental drift itself was already present as an alternate paradigm). These included:

(1) paleomagnetic studies that gave evidence of polar wandering (or continental motion);

(2) sea floor mapping of midocean ridges, trenches, and fracture zones;

(3) definition of discernible patterns in normal and reversed magnetic anomalies in the ocean crust; and

(4) the accumulation of sufficient seismic data from earthquake distributions to demonstrate a definite three-dimensional distribution of earthquakes in the crust.

These data were sufficient to lead to the widespread acceptance of plate tectonics. Greater confidence was inspired in the idea as several longstanding geological puzzles were supplied an explanation. These included orogenesis, sediment distribution on both continental and oceanic crust, and ophiolites.

Attraction of Plate Tectonics

One of the most attractive features of plate tectonic theory is its presumed ability to upgrade the discipline of geology by serving as a "grand unifying synthesis" of how the earth works. The nineteenth-century North American tradition of extensive and exhaustive field work (e.g., King Survey, the Powell Survey, the Wheeler Survey, (Faul and Faul, 1983)) that relied primarily on first hand observation of field data (e.g., outcrop mapping) was tedious, demanding, and did not rapidly build large datasets. This situation began to change during the first half of the twentieth century with the advent of the intense search for oil and gas.

Geology underwent a transition from a field mapping emphasis to a more integrated science in the early to mid twentieth century. Several factors drove this transition. The early twentieth-century oil and gas booms generated a cascade of information that gradually became available outside of proprietary corporations. New technologies of indirect data collection (seismic, remote sensing, sonar applications) and the evolution of existing ones (e.g., well logging) augmented the basic field and subsurface data with a plethora of information that demanded more sophisticated interpretation. Contemporaneous advances in data collection, storage, analysis and communication led to greater scales of cooperative effort. Finally, the global scope of the oil and gas exploration efforts led to the formulation of new ideas for predicting their occurrence as well as an economic impetus for unified global geologic theories. All of these external factors combined with the propensity of naturalistic uniformitarianism towards system building (Reed and Froede, 1996; Reed, 1996), and the demand for a single controlling concept for the integration of data.

Plate tectonic theory has achieved all that its early advocates had hoped for, if not more. It has become the concept around which earth science education is structured, from early grade levels to post-graduate research. Few workers openly question the concept, and most published interpretation of geologic data is done explicitly or implicitly in plate tectonic terms. Public interest in geology appears to be fueled as much by plate tectonic concepts as by dinosaurs, and any regular viewer of public television or one of the nature / science cable channels could probably identify the basic concepts of midocean ridge crustal creation, lateral plate motion, and subduction.

Catastrophic Plate Tectonics

Uniformitarians are not alone in their application of plate tectonic concepts to geologic data. Creationists have also explored aspects of plate tectonic theory in the past (Strickling, 1978; Tippetts, 1979; Bluth, 1983; Hansen, 1983; Cook, 1987; Baumgardner, 1987, 1990a, 1990b, 1994a, 1994b), and many have apparently accepted its basic outline as being congenial and complementary to the Biblical account of the Genesis Flood (Wise et al., 1994).

A critical method that utilizes similarities in uniformitarian and catastrophic plate tectonic concepts to streamline thought by lumping both positive and negative evidence for both forms of plate tectonics commends itself. Distinctions between uniformitarian and catastrophic plate tectonics models (as presented by Wise et al., 1994) are essential, because those distinctions also highlight similarities in both concepts that can be jointly evaluated (Table I). Application of identical contrary evidence to uniformitarian and cata-

Table I: Comparison of Uniformitarian and Catastrophic Plate Tectonics.

Similarities	Differences
Global crustal processes dominated by lateral motion of crust and upper mantle	Geologic time available for tectonic motions is orders of magnitude less for catastrophic plate tectonics
Size of the Earth essentially stable	Plate motions are much more rapid in catastrophic plate tectonics
New oceanic crust has been created at mid-ocean ridge spreading centers	Crustal upheaval and plate motions initiated by unique historical processes for catastrophic plate tectonics
Portions of the crust are subducted into the mantle and melted: The surface expressions are ocean trenches	Catastrophists infer that plate motions are probably one-time events
Orogenesis is directly related to rifting (oceanic) and subduction or collision (continental and oceanic)	Evolutionary interpretations of paleoenvironments and successions not accepted by catastrophic plate tectonics
Historical existence of one supercontinent, separated by rifting, and subsequent generation of new oceanic crust	Relationships between tectonics and the rock record are dissimilar between uniformitarian and catastrophic plate tectonics
Most large-scale geologic features can be related directly to global tectonic processes	

strophic plate tectonics based on those similarities allows a more coherent evaluation. Catastrophic plate tectonics is distinct in several basic ways from its uniformitarian counterpart. The primary distinction is the much shorter time frame of any young-earth model. This difference has several implications. The first is the necessity for more rapid plate motions, and more abrupt acceleration and deceleration of lithospheric plates. The limited time frame also precludes the repeated cycles of tectonic activity postulated by uniformitarians (e.g., the repeated opening and closing of the Atlantic Ocean (Wilson, 1966)). The second is the absence of constraint by the uniformitarian assumption of continuity of geologic processes through time. Therefore, in a gross sense, the causal mechanism for triggering and/or changing plate motions for current catastrophic plate tectonics models is the Genesis Flood, and is thus dissimilar to any present day mechanism (some creationists posit post-Flood initiation of plate motions, but the point remains the same, since any mechanism would be dissimilar from present day geologic processes).

Distinctions should also be made in the types of evidence acceptable to creationists. Paleontological correlations between separated landmasses have been proposed as support for continental drift (Wegener, 1929; Colbert, 1985). If this evidence supports uniformitarian models of plate motions (i.e., similar geologic and biotic examples between continents) is it acceptable to creationists? Certainly not in the sense of the evolutionary basis for pigeonholing the correlations. Do these correlative flora and fauna represent continental separation of identical paleoenvironments, or do they represent the global nature of both the historical setting and the depositional processes? Recent models suggest billions of years for convective mantle flow based on mixing considerations (Davies, 1990). Are these mantle convection models acceptable as potential explanations of plate motion causes? Again, the answer must be negative, based on the biblical historical record. The stratigraphic similarities between continents relative to the uniformitarian timescale presents similar problems. For example, stratigraphic evidence suggests a Mesozoic opening of the present-day Atlantic Ocean. However, Wise et al. (1994) suggest continental separation at the onset of the Flood event. Combining these two assertions leads to the conclusion that the entire Paleozoic record was deposited prior to the Flood. Another distinction would be in the use of radiometric dating to support relative ages for magnetic anomalies which in turn provide a spreading rate at midocean ridges and across hot spots (e.g., the Hawaiian Islands and the area around Yellowstone, Wyoming). Both evolutionists and creationists accept the metaphysical concept of unidirectional, linear time, but the magnitude of this vector is disputed. Without the means to quantitatively reduce generally accepted uniformitarian timescales to Biblical magnitudes, radiometric and other means of measuring absolute time are of questionable relevance when the attempt is made to introduce them quantitatively into a young-earth model (Froede, 1995; Walker, 1994).

Reasons for Skepticism

Most uniformitarian and many catastrophist geoscientists accept plate tectonics explanations with few reservations. Although we applaud the effort of Wise et al. (1994) in attempting to address plate tectonic concepts within the context of the Genesis Flood, we believe that a certain level of skepticism is warranted for any plate tectonics approach. It is also appropriate for other global-scale models such as the Hydroplate Theory of Brown (1995). This caution is based on several factors which are detailed as follows.

No uniformitarian scientist or philosopher that the authors are aware of has offered an explanation for how to classify plate tectonics as an intellectual construct. Wise et al. (1994) do not address this issue. either. As with any other explanation of the past based on indirect evidence, plate tectonics can at least be classified as a mixed question! However, no one has defined which intellectual disciplines should contribute in what order of precedence to the concept. What are the relative contributions of geology, anthropology, biogeography, history, philosophy, and theology? Unless some answer can be supplied, the precise formulation of evidence either for or against plate tectonics becomes problematic; only geologic evidence is ac-

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[1] The mixed question approach as defined by Adler (1965) recognizes that each intellectual discipline is based on its own special methods and special questions. When questions arise that cross disciplinary lines, they are addressed by a combination of disciplines (e.g., science and philosophy). and are considered mixed questions because they are not exclusively within the domain of any single discipline.

cepted and no satisfactory conclusion can be reached. We encourage the classification of plate tectonics as a system of thought by the philosophers of science within the mixed question context to facilitate the discussion regarding its application to geological datasets.

As an interim approach, we suggest that one basic principle of Earth history studies should be that models should be constrained from the top down and developed from the bottom up. In other words, the foundation of any model of earth history will be determined by philosophical and theological assumptions and the skeleton may well be provided by extrascientific information (e.g., the Biblical historical record). Field data should be used to flesh out the model, and address issues not addressed by non-geological information. For example, the Biblical record clearly tells of a global flood. Any geological concept of history that does not recognize a global flood is wrong at the outset. A true understanding of Earth history is constrained by the recognition of a global flood apart from scientific investigation. The nature of the detailed processes that occurred in the past, however, is determined from field investigation of their products in the rock record. Precision in evaluating such a model depends on the precision of the distinctions drawn between these different sources. More details of this methodology can be found in (Reed and Froede, 1996; and Reed, 1996). Until this weakness is resolved for all comprehensive geodynamic models, critical evaluation will be limited, but is still profitable within these limits.

Catastrophic plate tectonics is a derivative concept of uniformitarian plate tectonics, and thus offers a shortcut method of critical evaluation. Since it is dependent on the fortunes of uniformitarian plate tectonics, evidence both *pro* and *con* relating to uniformitarian plate tectonics is relevant to catastrophic plate tectonics. Distinctions between uniformitarian and catastrophic plate tectonics provide an opportunity for: (1) the solution of existing problems in uniformitarian plate tectonics by catastrophic plate tectonics, or (2) the introduction of additional new problems by catastrophic plate tectonics. Until advocates of catastrophic plate tectonics can demonstrate the former (so as to show that catastrophic plate tectonics is not redundant), and resolve any new problems, their model is incomplete. The accumulation of new datasets continues. If the then-new datasets of the 1950s and 1960s led to the abandonment of previous models in favor of plate tectonics, where will future discovery of additional new datasets lead? Additionally, the key data that support plate tectonics are new; as they mature, different interpretations may become preferred.

Acceptance of plate tectonics by creationists should be done cautiously. One obvious reason is the creationist tenet of a young Earth with the accompanying constraints of a several thousand year time frame for all geologic activity implied by the rock record. Also, the application of Occam's Razor would support less complex models of geologic change, and would force the question: "Is continental relocation necessary?" Catastrophists need not agree with current uniformitarian beliefs in the absence of compelling empirical evidence. Thus, drifting continents may be an unnecessary burden for the Creationist-Diluvialist paradigm. In fact, it may be an impossible one, since continental displacement within a very short time span requires massive heat flow from new ocean crust as well as seismic activity on a scale that is difficult to even model, much less demonstrate.

Table II: Evidence Pertinent to Plate Tectonics.

Evidence Supporting Plate Tectonics	Evidence Not Supporting Plate Tectonics
Apparent division of the crust into distinct interlocking plates based on the distribution of seismic activity, trenches, ridges, and fracture zones	Inability to define a convincing mechanism that would accommodate crustal properties, required motions including accelerations and decelerations, and in the case of catastrophic plate tectonics, the extremely limited time frame
Observed seismic and orogenic activity heavily weighted to defined plate margins	The relative importance of various datasets appears to be defined by the model, rather than more objective criteria
Crustal motion between scattered points inferred from geodetic measurement	Present day unambiguous plate motions not observed
Age-dating of oceanic crust in cross section from mid-ocean ridges landward, heat flow measurements, and the presence of symmetric magnetic anomalies at midocean ridges support sea-floor spreading	Primary datasets (i.e., magnetic anomalies, distribution of seismicity, nature and distribution of ocean floor features) questioned by more recent data and by reevaluations of earlier interpretations
Three-dimensional arrangement of earthquake foci at certain plate boundaries, the relationship of island arc and mountain chain physiography and chemistry to oceanic trenches, and seismic tomographic imaging of descending crust support subduction of lithosphere into the mantle	New datasets such as the imaging of continental "roots" at great depths are difficult to explain in the context of plate tectonics
Age distribution of crustal features such as ocean floors, orogenic belts, and sedimentary basins, geomagnetic polar wandering calculations relative to age-dated rocks, and comparison of continental outlines supports continental joining and separation	Features such as basaltic magmatism explained uniquely by plate tectonic processes on Earth are not formed by plate tectonic processes on the moon, Mars, and Venus in the past

Evidence Cited in Support of Plate Tectonics

A wide variety of evidence has historically been submitted to demonstrate plate tectonics (Table II). Cronin (1992, pp. 13-14) has suggested that the evidence for plate tectonics can be summarized as follows:

> The actual cornerstone of plate tectonics is the collection of observations that unambiguously shows that, among other things, (1) Earth's outer surface is composed of an interlocking array of lithospheric plates, (2) most earthquakes and magmatic activity occurs along the margins of plates, (3) all plates are in motion relative to one another,

> (4) plates diverge along the mid-ocean ridges, where new crust forms to fill the gaps, in a process known as sea-floor spreading, (5) mantle lithosphere is resorbed as it sinks into the deeper mantle in subduction zones, (6) the bathymetry of ocean basins is related to the variation in age and thermal structure of the plates, (7) the apparent offset of midocean-ridge segments is opposite to the actual sense of slip along the intervening transform fault, (8) oceanic fracture zones emanate from both ends of a given transform fault, (9) collision of continental lithosphere is a mechanism for the generation of mountain ranges, and (10) the oldest continental crust is Archean in age, whereas the oldest oceanic crust that is still in an ocean basin is Jurassic."

Additionally, evidence has been historically offered for the past existence of a unified landmass or supercontinent (Pangea). Wegener (1929) originally proposed that measured drift rates (Wegener's efforts in this area are not presently considered valid), SIAL (silica / aluminum rich continental crust) isostasy, polar wandering, transoceanic alignment of orogenic belts, and paleontological correlations between presently separated continents supported his concept of continental drift. Historically plate tectonics has provided explanations for previously problematic phenomena such as terrane accretion (both suspect and exotic), ophiolite suites, midocean fracture zones (transform faults), and hot spots. The breadth of explanatory power has always been considered one of the major strengths of plate tectonics. However, those explanations are not unique to plate tectonics, as will be discussed in detail in future papers in this series.

Wegener's concept of continental drift was rejected primarily because he could not provide an adequate mechanism to explain drift. Continental drift was tied to sea floor spreading by Hess (1962), and supported by the comparison of magnetic anomalies symmetric to the midocean ridge (Vine and Matthews, 1963; Phinney, 1968; Cox, 1973). The discovery of midocean ridge volcanoes is also considered to be evidence for sea-floor spreading (Corliss and Ballard, 1977). Recent studies in seismic tomography (3-D imaging from sources at depth) are cited to demonstrate convective flow in the mantle (Anderson and Dziewonski, 1984; Burnett, Caress and Orcutt, 1989), which is alleged to provide the mechanism for plate motions. The corollary of sea floor spreading on a non-expanding Earth is the subduction of crust into the mantle. Proposed evidence for subduction has included the spatial distribution of medium and deep-focus earthquakes at plate boundaries and volcanic chemical composition variations relative to plate boundary location. In addition to these lines of evidence, modern plate motions are asserted to be demonstrated by various geodetic calculations (Argus and Heflin, 1995).

A wide body of existing literature discusses these points and many others. The scope of this paper precludes the detailed discussion of each point either for or against the plate tectonics assertions. However, these will be discussed in future contributions by the authors.

Additional Evidence Cited for Catastrophic Plate Tectonics

An explicit metaphysical framework allows those operating within a Biblical-Christian framework to apply other evidence to the issue of plate tectonics. First and foremost, the historical record of the Scripture provides a basis for interpretation. The onset of the Genesis Flood marked the greatest single physical discontinuity in earth process recorded in the Bible. The terms used to describe the Flood are graphic and unambiguous. The exposition of terms such as ". . . all the fountains of the great deep burst open . . ." (Genesis 7:11, NASB) immediately gives rise to physical associations to those educated in geology. One possible interpretation is the one supplied in Wise et al. (1994) that the reference to the breakup of the fountains of the great deep refers to an episode of rifting, plate motion, and subduction. Although this interpretation may do no violence to the text of Genesis, the question of whether it is the only possible one has not been addressed. If other interpretations are possible for this and similar passages, then other evidence will be necessary to distinguish the truth between them. This evidence may be found both within Scripture and outside it. If all evidence within Scripture does not resolve this interpretation issue, then only physical evidence remains, with a corresponding decreased level of confidence in any interpretation.

Arguments Against Plate Tectonics

In spite of the quantity of data presented in support of plate tectonics, others have also presented information opposing plate tectonic interpretations (Table II). Advocates of other views of global tectonics often focus their criticisms on mechanisms proposed for historical plate motions. The most commonly accepted mechanism is mantle convection. However, explanation of mantle convection and its relationship to plate motions is not resolved (Frankel, 1988; VanDecar, James, and Assumpcao, 1995). Proposed mechanisms for subduction are especially criticized, and rejection of subduction combined with acceptance of sea-floor spreading support expanding Earth theories (Owen, 1992). Problems with mechanisms focus on strength of materials versus uniform acceleration over large areas and edge-deceleration during subduction of crustal material into the mantle. Catastrophic plate tectonics appears to circumvent numerous physical mechanisms proposed by uniformitarian plate tectonics, such as long-term ductility of rock material, and gravity / density sinking of oceanic crust (i.e., isostasy). This is due to the relatively high velocities and accelerations required by catastrophic plate tectonics. Although Baumgardner (1994a, 1994b) has provided numerical modeling in support of conceptual motions, additional analysis is required, if for no other reason than the incomplete physical description of plates and their motions in the Wise et al. (1994) paper.

The generational aspects of plate tectonic acceptance in the 1960s and 1970s (younger scientists accepted; older scientists rejected) has had repercussions that have not yet been fully realized. Acceptance of plate tectonics represented a corresponding paradigm shift away from traditional datasets and methods of geology to different datasets and methods, especially geophysical ones (Wood, 1985). Only continued progress in the earth sciences will show whether or not the new emphases of the younger plate tectonics advocates are more relevant than those of the older generation.

Two issues arise from this directional change in the discipline. The first is that of the relevance of popular datasets used as evidence for plate tectonics models compared to previously existing datasets, and the second is the relevance of the plate tectonics evidential datasets compared to future knowledge. The latter issue will by definition only be resolved in the future, and it highlights the uncertainty of scientific interpretations of past events. Thus, several relevant questions would include:

(1) Are the selected new datasets adequate to support tectonic theory?
(2) Are the selected new datasets consistent with previously developed datasets (do the selected datasets force conclusions contradicted by other datasets)?

The first question attempts to remove the excessive emphasis placed on newfound discovery from plate tectonic theory and reassess new knowledge. For example, the mirror image magnetic anomalies parallel to spreading centers were a primary part of the evidence for plate tectonics. Do the anomalies remain compelling evidence after they are subjected to more rigorous quantitative assessment (Agocs, Meyerhoff, and Karoly, 1992)? Again, plate tectonics predicts a fundamental difference in the crustal composition of ocean versus continental crust. How does the possible existence of continental crust underlying parts of ocean basins (e.g., the northwest Pacific Ocean basin (Choi, Vasil'yev, and Bhat, 1992)) fit with the accepted theory that all oceanic crust is basalt, formed at midocean ridge spreading centers?

The second utilizes prior knowledge to make a similar assessment. Geologic and paleontologic evidence have been in print for decades that indicate the close proximity of India to Asia since Paleozoic time. Existing plate tectonic models place the Indian subcontinent apart from Asia and close to Africa and Madagascar until relatively recently. How are these conflicting data to be evaluated, and which will take precedence (Smiley, 1992)?

Any assessment is limited by the existing limits on current knowledge of the Earth and geological processes. All proposed mechanisms for either form of plate tectonics originate in the Earth's interior. Yet how many of the properties of the Earth's interior can be directly observed or measured? Only heat flow near the surface, mass, density, surface gravity / magnetic fields, and seismic velocity through the interior are actually measurable; other properties (often confidently discussed) are inferred or assumed. Note that meteorite data are interesting but of uncertain relevance to the Earth's interior composition, since the bulk density of all but the nickel-iron types is grossly inadequate to account for the observed density of the Earth. Of course, analogies with nickel-iron meteorites may also be invalid as indicators of the Earth's interior. This follows from the fact that any putative analogy between planetary interiors and meteorites is a child of cosmic evolutionary theory, not empirical analysis. It seems as though every major new discovery about the outer planets of our solar system has generated some new challenge to these same theories. Additionally, the absence of pressure features in nickel-iron meteorites suggests that either these meteorites were never derived from planetary interiors, or that they have been so altered that they are not reliable indicators of planetary interiors.

Plate tectonics theory by its comprehensive nature makes two demands that can be difficult to reconcile. The first is that it explain all relevant datasets in some fashion (because it is a global unifying theory) and the second is that it defines which datasets are relevant and what their evidentiary priority is (for the same reason). In other words, since it must explain all data, and if some data apparently do not fit the hypothesis, then the data must be the problem, not the hypothesis. In this manner, at least, plate tectonics shows similarity to evolution, which also must explain all relevant data while simultaneously defining which data are relevant.

There are a number of specific problems that have been raised in opposition to plate tectonic theory. Many of these are ignored or dismissed because there is an apparent preponderance of evidence supporting plate tectonics. However, as noted above, any theory that purports to explain everything, must. Thus, small problems are either problematic data that will be changed with more data acquisition, or are indicators that the hypothesis is wrong at least in part. Some of the problems include:

(1) geologic evidence of extension at supposed convergent plate margins (Hamilton, 1988; Bevis et al., 1995);
(2) difficulty of explanation of continental interior tectonics and seismicity (Kahle, 1974; Molnar, 1988; Grant, 1992);
(3) the inconclusive nature of recent geodetic measurements of the Pacific basin relative to present day motions (Owen, 1992);
(4) physical features of the midocean ridges that do not appear to support orthogonal motions (Carey, 1988) and the presence of physical features suggesting ridge-parallel motions in the crust (Meyerhoff et al., 1992);
(5) zones of large-scale compressional thrust faulting on the flanks of the midocean ridge rather than the expected tensional features (Meyerhoff et al., 1992);
(6) features associated with plate tectonic processes on the moon, Mars, and Venus independent of plate tectonic processes (Lowman, 1992);
(7) seismic tomographic expression of the deep structures of continental crust that would hinder or preclude movement relative to the mantle (Lay, 1988; Shearer, 1988; Meyerhoff et al., 1992; VanDecar et al., 1995);

(8) evidence of no large-scale strike-slip faulting along the San Andreas fault (Martin, 1992; Oard, 1992);

(9) difficulty in explaining physical features of oceanic trenches (Fisher, 1974; Bloomer, 1983; Cloos, 1984; Bloomer and Fisher, 1987)

(10) heat flow measurements that do not follow predicted patterns (Meyerhoff et al., 1992); and

(11) plates surrounded by spreading features with no apparent offsetting subduction (Africa), and plates surrounded by subduction with no apparent offsetting spreading (Caribbean) (Hamilton, 1988).

Alternate Geodynamic Theories

Since catastrophic plate tectonics is derivative of uniformitarian plate tectonics, an examination of alternate geodynamic theories to uniformitarian plate tectonics can provide another means of evaluating potential challenges to catastrophic plate tectonics. A variety of geodynamic theories have come and gone during the history of geology. Historically they can be considered in terms of the size of the Earth through time. Earth contraction, Earth expansion, and stable Earth hypotheses have all been proposed. Both uniformitarian and catastrophic plate tectonics concepts appear to adhere to a stable size history of the Earth. Earth contraction theories have not been pressed since the advent of plate tectonics, since most were developed to explain crustal compression (for a major exception, see the following discussion of Surge Tectonics). However, Earth expansion ideas still compete as a minority view with plate tectonics concepts. The most recognized advocate of Earth expansion concepts is Samuel Warren Carey (l911-) of the University of Tasmania. Just as the continental fit of Africa and South America has been a standard argument for continental drift for many decades, Earth expansion is illustrated by the terrella models of Vogel (1983) which show a fit of all the continents that would completely cover the surface of the Earth at approximately 40% of its current diameter. Although disagreement remains on the rate and mechanism(s) for expansion, many geologists have been persuaded by the arguments of the expansionists that the Earth does expand through time at least to some degree.

Other concepts and variations on existing concepts can be found by careful search of the literature. Prior to his death, Arthur A. Meyerhoff (Meyerhoff et al., 1992), perhaps the most visible critic of plate tectonics in geology, published a massive critique of uniformitarian plate tectonics while simultaneously advocating a new concept of geodynamics called “Surge Tectonics.” He and his co-authors advocate the foldbelt-parallel movement of less rigid asthenospheric material in surge channels within the cooler lithosphere. The trigger for surges or pulses of magmatic migration (that would correspond to orogenesis) is episodic contraction of the lithosphere driven by uniform contraction of the strictosphere (upper mantle), and mediated by the less rigid asthenosphere. Thus the magmatic migration under the midocean ridges would be parallel to the ridge instead of at right angles to it. Consequently, sea-floor spreading would not occur, and no “conveyor belt” motion of the mantle would exist that could drive subduction. The surface crustal expression of surge channels are the continental and oceanic foldbelts of the Earth. A wide selection of international geological and geophysical data is presented in support of this concept at the expense of uniformitarian plate tectonics. The ongoing presence of minority geodynamic models demonstrates areas of weakness in conventional plate tectonics that must be overcome or shown to be irrelevant in catastrophic plate tectonics.

Conclusion

A review of the data available to geologists today could not fail to impress any researcher, especially in comparison to the state of the discipline even 50 years ago. However, it is unlikely that sufficient data exist to generate a comprehensive unifying theory of how the Earth works even at the present. The historical dimension, moreover, forces any such theory to become a mixed question, and open to criticism from information gained outside of the earth sciences. Even though very few would recognize the necessity of a mixed question approach to Earth history, it remains true that any unifying theory that relies only on geological and geophysical data is deficient.

The development of catastrophic plate tectonics implicitly accepts the mixed question approach, but does not explicitly address it. This results in a lack of coherence in the method of applying information outside of physical sciences (e.g., the Scriptural references do not appear to uniquely constrain the plate tectonics interpretations). As a derivative concept, catastrophic plate tectonics is susceptible to most criticisms of uniformitarian plate tectonics, and the distinctions between the two appear to generate additional difficulties for catastrophic plate tectonics in the one area of ongoing weakness in all plate tectonic theories—that of a credible physical mechanism for large-scale lateral plate displacement and subduction.

Creationists should certainly reject the current uniformitarian version of plate tectonics, although there may well be useful elements of truth in specific local analyses. Even a cursory reading of currently accepted plate tectonic literature is sufficient to conclude that the theory contradicts the Biblical record of Earth history. Catastrophic plate tectonics attempts a synthesis of the Scriptural account of the Genesis Flood and plate tectonics concepts. Any attempt by creationists to present concepts that incorporate existing geological and geophysical datasets is to be welcomed, and can only increase the relevance of the creationist worldview to the earth sciences. However, any present synthesis of Genesis and plate tectonics (e.g., Wise et al., 1994) is not convincing in its present form, and should be regarded with healthy skepticism until it is more fully developed. Similar skepticism should be exercised towards any current comprehensive geodynamic model such as the Hydroplate theory (Brown, 1995) for the more general reasons of imbalances between interpretation and supporting data.

Summary

(1) A variety of factors has combined to bring about the general acceptance of plate tectonic theory in geology. Plate tectonics has provided geology with a grand unifying theory of how the Earth works, and has proven to be publicly popular because of its simplicity and easy visualization.

(2) Acceptance of plate tectonics hinged on the development of new datasets rather than the reinterpretation of previously existing ones. The geological evidence submitted by Wegener (1929) was not convincing to a majority of geologists. New geophysical evidence developed in the post-World War II period was.

(3) In spite of several key differences, catastrophic plate tectonics is essentially a derivative concept of uniformitarian plate tectonics and these similarities allow the use of much evidence for and against uniformitarian plate tectonics to be used in any evaluation of catastrophic plate tectonics.

(4) Arguments against either type of plate tectonics must assess the new datasets offered by plate tectonics advocates, compare those datasets with previously existing datasets for consistency, and evaluate even newer datasets that are presently being developed.

(5) As a theory that purports to comprehensively explain how the Earth works, the validity of plate tectonics depends on its ability to explain all the evidence, not just a preponderance of evidence. “Small” problems recognized today may be the basis for a geodynamic revolution in the future (see Kuhn, 1970).

(6) Despite its widespread public and professional acceptance, there is an enduring and vocal minority of geologists that does not accept plate tectonics. Many support expanding Earth concepts, while others have generated original geodynamic theories. Comparison of data available to conclusions drawn from any existing comprehensive geodynamic theory demonstrates that skepticism of any current theory is appropriate.

(7) Skepticism is also the appropriate response to catastrophic plate tectonics, both for the reasons cited immediately above, and because the extrascientific grounds cited for the concept do not uniquely require that interpretation.

References

Adler, M. J. l965. The conditions of philosophy. Atheneum Press. New York.

Agocs, W. B., A. A. Meyerhoff, and K. Karoly. 1992. Reykjanes Ridge: quantitative determinations from magnetic anomalies. In S. Chatterjee and N. Hotton III (editors), New concepts in global tectonics. Texas Tech University Press. Lubbock, TX. pp. 221-238.

Anderson, D. L. and A. M. Dziewonski. 1984. Seismic tomography. *Scientific American* 251(4):60-68.

Argus, D. F. and M. B. Heflin. 1995. Plate motion and crustal deformation estimated with geodetic data from the global positioning system. *Geophysical Research Letters* 22(15):1973-1976.

Baumgardner, J. R. 1987. Numerical Simulation of the large-scale tectonic changes accompanying the flood. In R. E. Walsh and C. L. Brooks, (editors), Proceedings of the First International Conference on Creationism, Volume II. Creation Science Fellowship. Pittsburgh, PA.

———. 1990a. The imperative of non-stationary natural law in relation to Noah’s flood. *Creation Research Society Quarterly* 27:98-100.

———. 1990b. 3-D finite element simulation of the global tectonic changes accompanying Noah’s flood. In R. E. Walsh, (editor), Proceedings of the Second International Conference on Creationism, Volume II. Creation Science Fellowship. Pittsburgh, PA.

——— 1994a. Computer modeling of the large-scale tectonics associated with the Genesis flood. In R. E. Walsh, (editor), Proceedings of the Third International Conference on Creationism, Technical Symposium Sessions. Creation Science Fellowship. Pittsburgh, PA.

———. 1994b. Runaway subduction as the driving mechanism for the Genesis flood. In R. E. Walsh, (editor), Proceedings of the Third International Conference on Creationism, Technical Symposium Sessions. Creation Science Fellowship, Pittsburgh, PA.

Bevis, M., F. W. Taylor, B. E. Schultz, J. Recy, B. L. Isacks, S. Helu, R. Singh, E. Kendrick, J. Stowell, B. Taylor, S. Calmant. 1995. Geodetic observations of very rapid convergence and back-arc extension at the Tonga arc. *Nature* 374:249-251.

Bloomer, S. H. 1983. Distribution and origin of igneous rocks from the landward slopes of the Mariana Trench: implications for its structure and evolution. *Journal of Geophysical Research* 88, B9, 7411-7428.

——— and R. L. Fisher. 1987. Petrology and geochemistry of igneous rocks from the Tonga Trench—a non-accreting plate boundary. *Journal of Geology* 95:469-495.

Bluth, C. 1983. Convection currents in the Earth’s mantle: A mechanism for continental drift? *Creation Research Society Quarterly* 20:131-132, 193.

Brown, W. 1995. In the beginning: compelling evidence for Creation and the Flood. Center for Scientific Creation. Phoenix. 230 pp.

Burnett, M. S., D. W. Caress, and J. A. Orcutt. 1989. Tomographic image of the magma chamber at 12d50’ N on the East Pacific Rise. *Nature* 339:206-208.

Carey, S. W. 1988. Theories of the earth and universe. Stanford University Press. Stanford, CA.

Choi, D. R., B. I. Vasil’yev, and M. I. Bhat. 1992. Paleoland, crustal structure, and composition under the northwest Pacific Ocean. In S. Chatterjee and N. Hotton III (editors), New concepts in global tectonics. Texas Tech University Press. Lubbock, TX. pp. 179-191.

Cloos, M. 1984. Landward-dipping reflectors in accretionary wedges: active dewatering conduits? *Geology* 12:519-522.

Colbert, E. H. 1985. Wandering lands and animals. Dover. New York.

Cone, J. S. 1991. Fire under the sea. William Morrow. New York.

Cook. M. A. 1987. How and when “Pangea” ruptured and continents shifted. In R. E. Walsh and C. L. Brooks, (editors), Proceedings of the First International Conference on Creationism. Volume II. Creation Science Fellowship. Pittsburgh, PA. pp. 69-86.

Corliss, J. B. and R. D. Ballard. 1977. Oases of life in the cold abyss. *National Geographic.* 152(4):441-453.

Cox, A. 1973. Plate tectonics and geomagnetic reversals. W. H. Freeman. San Francisco.

Cronin, V. S., 1992. A kinematic perspective on finite relative plate motion, provided by the first-order cycloid model. In S. Chatterjee and N. Hotton III (editors), New concepts in global tectonics. Texas Tech University Press. Lubbock, Texas. pp. 13-21.

Davies, G. F. 1990. Mantle plumes, mantle stirring and hotspot chemistry. *Earth and Planetary Science Letters* 99:94-109.

Dewey, J. F., and J. M. Bird. 1970. Mountain belts and the new global tectonics. *Journal of Geophysical Research* 75(14):2625-2647.

Dietz, R. S. 1961. Continent and ocean basin evolution by spreading of the sea-floor, *Nature* 190:854-857.

Ewing J. and M. Ewing. 1959. Seismic-refraction measurements in the Atlantic Ocean basins, in the Mediterranean Sea, on the Mid-Atlantic Ridge, and in the Norwegian Sea. *Geological Society of America Bulletin* 70(3):291-317.

Faul, H. and C. Faul. 1983. It began with a stone: A history of Geology from the Stone Age to the age of plate tectonics. John Wiley. New York.

Fisher, R. L. 1974. Pacific-type continental margins, in The Geology of Continental Margins. C. A. Burk and C. L. Drake, (editors). Springer-Verlag. New York, pp. 25-41.

Frankel, H. 1988. From continental drift to plate tectonics. *Nature* 335:127-130.

Froede, C. R., Jr. 1995. A proposal for a creationist geological timescale. *Creation Research Society Quarterly* 32:90-94.

Glen, W., 1982. The road to Jaramillo. Stanford University Press. Stanford, CA.

Grant, A. C. 1992. Intracratonic tectonism: Key to the mechanism of diastrophism. In S. Chatterjee and N. Hotton III (editors), New concepts in global tectonics. Texas Tech University Press. Lubbock, TX. pp. 65-73.

Hamilton, W. H. 1988. Plate tectonics and island arcs. *Geological Society of America Bulletin* 100:1503-1527.

Hansen, Patrick L. 1983. The necessity of continental re-location in the creationist model. *Creation Research Society Quarterly* 19: 206-225.

Heezen, B. C., 1962. The deep-sea floor, in Continental Drift, S. K. Runcorn (editor), pp. 235-288. Academic Press. New York.

Hess, H. H. 1962. History of the ocean basins, in Petrologic studies: A volume to honor A. F. Buddington, A. E. Engel et al. (editors), pp. 599-620. Geological Society of America. New York.

Kahle, C. F. (editor). 1974. Plate tectonics-assessments and reassessments. American Association of Petroleum Geologists Memoir 23.

Kuhn, Thomas S., 1970. The structure of scientific revolutions. The University of Chicago Press. Chicago.

Lay, T. 1988. The deep roots of continents. *Nature* 333:209-210.

Lowman, Paul D. 1992. Plate Tectonics and continental drift in education. In S. Chatterjee and N. Hotton III (editors), New concepts in global tectonics. Texas Tech University Press. Lubbock, TX. pp. 3-9.

Martin, B. D. 1992. Constraints to major right-lateral movements, San Andreas fault system, central and northern California, USA. In S. Chatterjee and N. Hotton III (editors), New concepts in global tectonics. Texas Tech University Press. Lubbock, TX. pp. 131-148.

Menard, H. W., 1986. The ocean of truth. Princeton University Press. NJ.

Meyerhoff, A. A., I. Taner, A. E. L. Morris, B. D. Martin, W. B. Agocs, and H. A. Meyerhoff. 1992. Surge tectonics: A new hypothesis of Earth dynamics. In S. Chatterjee and N. Hotton III (editors), New concepts in global tectonics. Texas Tech University Press. Lubbock, TX. pp. 309-409.

Molnar, P. 1988. Continental tectonics in the aftermath of plate tectonics. *Nature* 335:131-137.

Oard, M. J. 1992. What is under the surface? *Creation Research Society Quarterly* 29:27-28.

Owen, H. G. 1992. Has the Earth increased in size?. In S. Chatterjee and N. Hotton III (editors). New concepts in global tectonics. Texas Tech University Press. Lubbock, TX. pp. 289-296.

Phinney, R. A. 1968. (editor) The history of the Earth's crust. Princeton University Press. NJ.

Reed, J. K. and C. R. Froede, Jr., 1996. A biblical Christian framework for Earth history research: Introduction to the series. *Creation Research Society Quarterly* 32:228-229.

____________,1996. A biblical Christian framework for Earth history research: Part I—Critique of the naturalist-uniformitarian system. *Creation Research Society Quarterly* 33:6-12. (Remainder of series in prep.).

Shearer, P. 1988. The fossil roots of continents. *Nature* 335:11-12.

Shepard, F. P. 1963. Submarine geology, second edition. Harper and Row. New York.

Smiley, C. J. 1992. Paleofloras, faunas, and continental drift: Some problem areas. In S. Chatterjee and N. Hotton III (editors), New concepts in global tectonics. Texas Tech University Press. Lubbock, TX. pp. 241-256.

Strickling, J. E. 1978. Peleg's division. *Creation Research Society Quarterly* 15:159-160.

Tippetts, M. W. 1979. Pangea Shattered. *Creation Research Society Quarterly* 16:7-15.

VanDecar, J. C., D. E. James, and M. Assumpcao. 1995. Seismic evidence for a fossil mantle plume beneath South America and implications for plate driving forces. *Nature* 378:25-31.

Vine, F. J. and D. H. Matthews. 1963. Magnetic anomalies over oceanic ridges. *Nature* 199:947-949.

Vogel, K. 1983. Global models and Earth expansion. In Carey, S. W. (editor), Expanding Earth symposium. Sydney (1981). pp. 17-27. University of Tasmania.

Walker, T. 1994. A Biblical geologic model. In Walsh, R. E. (editor), Technical Symposium Sessions. Proceedings of the Third International Conference on Creationism. Creation Science Fellowship. Pittsburgh, PA. pp. 581-592.

Wegener, A. 1929. Die Entstehung der Kontinente and Ozeane. Fourth edition. John Biram, translator. Dover Publications. New York.

Wilson, J. T. 1966. Did the Atlantic close and then re-open? *Nature* 211:676-681.

Wise, K. P., S. A. Austin, J. R. Baumgardner, D. R. Humphreys, A. A. Snelling, L. Vardiman, 1994. Catastrophic plate tectonics: A global Flood model of Earth history. In Walsh, R. E. (editor), Technical Symposium Sessions. Proceedings of the Third International Conference on Creationism. Creation Science Fellowship. Pittsburgh, PA. pp. 581-592.

Wood, R. M., 1985. The dark side of the Earth. Allen and Unwin. London.

A BIBLICAL CHRISTIAN FRAMEWORK FOR EARTH HISTORY RESEARCH PART II-FOUNDATION AND METHOD OF HISTORICAL ANALYSIS WITHIN THE BIBLICAL CHRISTIAN SYSTEM

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Abstract

Although the naturalist-uniformitarian system and its derivative view of earth history are demonstrably invalid, a biblical Christian substitute is not logically a de facto replacement. It must first succeed at the points of failure of the naturalist system. In this paper I attempt to show that the biblical Christian system is successful in passing these tests as it demonstrates internal consistency in developing a framework within which historical analysis can take place. Additionally, the epistemological framework of the system is shown to integrate geological models of earth history, separable from the system, in a comprehensive approach to historical analysis.

Introduction

In Part I of this contribution I noted two tasks involved in the development of a viable interpretation of earth history. These include: (1) the refutation of the dominant naturalist-uniformitarian system and (2) the introduction of an alternative that successfully addresses the failures of that system. Demonstrated contradictions between the fundamental axioms of the naturalist-uniformitarian system on the one hand and its methodology and conclusions on the other invalidate it. The remaining positive task is then to demonstrate the validity of a replacement. The biblical Christian system can successfully address the failings of the naturalist system by these means;

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1. demonstrating *internal consistency* between its foundational axioms on the one hand and methods and conclusions on the other to validate assumptions necessary to constrain and generate models,
2. justifying *methods* in earth history analysis by applying an epistemological framework consistent with the biblical Christian system,
3. proposing geologic *models* of earth history once that framework is established. Each model must be constrained by several criteria, including:
   a. consistency with the metaphysical system,
   b. consistency with the epistemological framework and method,
   c. well defined limits that will insure that the model is separable from the framework in a methodological sense, and,
   d. clearcut criteria by which the model can be revised or rejected based on empirical evidence.

The first three criteria (a-c) must be supplied outside science but are conditions that constrain and shape scientific models. The last criterion (d) is influenced by field data, and the process it describes is most closely related to what is commonly considered the "scientific method." This restriction of the scientific method implies similar restrictions on science, and will certainly be rejected by adherents of the naturalist-uniformitarian system.

The first three items highlighted above (a-c) will be the subjects of this paper. In developing an epistemological framework that will constrain the method of historical analysis, the issue of the separability between models and the underlying system will also be addressed. Success of the biblical Christian system in these tasks will parallel corresponding failures of the naturalist-uniformitarian system, which were partially presented in Part I of this contribution (Reed, 1996, pp. 6-12). Additional epistemological failures of the naturalist-uniformitarian system highlight the corresponding successes of the biblical Christian system.

Passing Formal Tests

Evaluation of any successful model of geologic history must first include the ability of its parent system to pass formal tests of *internal* consistency. This ability is primary in the sense that it must precede the application of *external* empirical tests. No empirical evidence can offer support to the truth claim of a model generated within a self-contradictory system. For this reason, the geologic column, as a part of the naturalist-uniformitarian system, cannot possibly be true, unless new philosophical or religious conclusions are drawn about the nature of the cosmos, of man, and of history, that are consistent with the central tenets of naturalism, and justify the method and conclusions of uniformitarian historical analysis. Because a successful overhaul of uniformitarian thinking does not appear likely, a biblical Christian alternative is offered.

The biblical Christian alternative to historical analysis must pass the same formal tests failed by the naturalist-uniformitarian system. In Part I of this series, the failures of naturalism-uniformitarianism resulted from the systematic use of biblical Christian axioms to support anti-biblical conclusions. The success of the biblical Christian alternative in passing the formal tests described above has already been documented in Part I (Reed, 1996, pp. 6-12), in which the biblical Christian axioms are shown to be consistent with biblical Christian methods and conclusions. The results from Part I include four propositions:

1. Science can exist because nature as the artifice of an orderly, transcendent God justifies the comprehensibility of phenomena by a mechanistic method that is the result of a metaphysic that relates phenomena to transcendent reality.
2. Human participation in science is possible because man is the image-bearer of God. Man thus transcends nature as a potential observer, and has an inherent ability to understand to some degree God's works.
3. Novel, empirical scientific progress is possible because nature follows the orderly, yet novel dictates of God's will as opposed to an inherent natural, rational order; man, the scientist, exists in a unique historical relationship with God that frees him from potential deterministic forces of both history and nature.
4. Science is motivated and justified as a human enterprise by the creation mandate of Genesis 1:28, which crystallizes the interrelationships between God, man, nature, and history.

Formal tests presented above do not supply an exhaustive evaluation of the two systems. In addition to the justifications of science in the biblical Christian system discussed above, a brief examination of the framework reveals the following additional conclusions which are essential to the task of geologic historical analysis:

1. the affirmation of discontinuity in earth history,
2. the objective reality of nature and time apart from the human mind, and
3. the primacy of historical events over the mode of time in which they occurred.

Discontinuity is implied by the active participation of a transcendent purposeful God in earth history. Likewise the existence of God as eternally self-existing, free (to create or not), and separate from nature in terms of existence and dependency provide the basis for the objective reality of nature and time as created entities. Ultimate reality is dependent on the will of God, rather than the mind of man or phenomena. God's interaction with man in history grants primacy to their relationship illustrated by the *events* that occur in history, rather than to the historical "process" in which those events occur.

Clarifying The Epistemological Foundation

Because epistemology is the study of the nature of knowledge, especially its limits and validity, any model of earth history must be supported by an epistemological framework that can justify the search for truth in history. A full-orbed discussion of epistemological issues is well beyond the scope of this paper, and the author welcomes future contributions from professional philosophers of science in this arena. There are, however, several epistemological concepts that relate directly to the formulation of geologic models of earth history, and those issues will be addressed below.

The biblical Christian system underlies the classical structure of western thought. It delineates distinct areas of knowledge and demands both vertical and horizontal relationships between these areas. The biblical Christian system also justifies a relationship between human knowledge and truth, and can apply this framework to the issue of historical analysis. In contrast, the naturalist-uniformitarian system distorts science to reject the very structure of western thought that provided a foundation for modern science (see critique in Reed, 1996). This internal contradiction in the naturalist-uniformitarian system is revealed in its emphasis on science as the only valid knowledge. This claim discredits other areas of knowledge that are required to justify the practice of science. The dismissal of these other facets of knowledge also precludes constraints on science. The attempt to apply science outside of its proper limits has negative scientific and philosophical results.

The Failure of Knowing in Naturalism

The preceding formal tests have illustrated that key concepts in the development of modern science depended on key developments in Christian theology. God's relationship with nature guaranteed that the physical universe was a "mechanical" artifact brought about through intelligent design. God's relationship with man (made in His image) guaranteed the transcendent aspect of man that justified his external, objective analysis of nature and history as aspects of creation. Man existed as an historical being, focused on his relationship to God and to his mission in fulfilling the will of God on earth. Success in the pursuit of scientific knowledge was guaranteed by the unity of truth in God, even when that unity was not immediately apparent because of focused, piecemeal investigation or human limitations. Ongoing theological and philosophical confusion was eliminated. The justification of every scientific concept was no longer considered necessary, since the theological and philosophical foundations had already been laid, and the nature of God insured goodness of "fit" for the individual pieces of truth. Naturalism fails in two significant ways to provide an internally consistent epistemological basis for its own method. The first failure lies in its deviation from the traditional epistemological structure of western thought. The second failure is a dependence on system-building trends in pre-twentieth-century modern philosophy, followed by the failure to update its philosophical base after those earlier trends were discarded during the twentieth century.

The Naturalist Rejection of the Structure of Western Thought

Ironically, part of the triumph of the biblical basis for modern science was the ability to draw clear distinctions between theology and science. For example, the divorce of purpose from scientific inquiry was not based on the unimportance of purpose per se, but on the transfer of purpose from nature to God. The links between science, theology, and philosophy were not severed, they were merely arranged in such a way as to allow free exercise of the scientific process within the limits set by theology and philosophy. Science was thus linked in a dependent manner to theology and philosophy; the mechanistic, empirical method was made possible by underlying theological and philosophical conclusions.

From the perspective of the practicing scientist, however, philosophy and theology were in "background memory," and not particularly applicable to day-to-day tasks. The early secularists of the Enlightenment apparently did not understand that the background status of theology and philosophy in operational science did not diminish their fundamental importance. Already in the background, and weakened by internal difficulties during the eighteenth and nineteenth century, philosophy and theology were easily jettisoned. The necessary presuppositions that were formerly supplied to science by theology and philosophy were assumed to naturally inhere within science itself. Unfortunately, the severing of this epistemological connection with theology and philosophy allowed the transition within science from a mechanistic method to a mechanistic metaphysic which could not support the mechanistic method (Glover, 1984). What has not yet been realized by modern scientists is that in the midst of their triumph over "religious superstition," they have lost the justification for their most foundational axioms. The foundation has been laid for the self-destructive implosion of science, and that self-destruction will accelerate as these issues are more widely appreciated.

In the uniformitarian system, replacing God with nature as the ultimate reality was necessarily accompanied by the epistemological promotion of science as the replacement for revelation, theology, and first order philosophy (Schlossberg, 1983, p. 143). The naturalist-uniformitarian denial of validity outside of science rests upon certain nineteenth century philosophical conclusions regarding science and knowledge that culminated in the philosophical school of "logical positivism," which was quickly rejected or modified by secular philosophers (Medawar, 1984, p. 66). This attempt to define truth in terms of science is similar to other faults of naturalism described in Part I of this series. The replacement of other areas of knowledge by science was performed only on a surface level, and the underlying basis for applying human knowledge was not fully integrated into the naturalist system, primarily because it could not fit.

Although uniformitarians have attempted to subvert the traditional structure of knowledge, the opposing tradition of western thought derived from biblical Christianity offers the only possibility for maintaining the link between human knowledge and truth. Science never had the ability to provide the meaning and purpose by which the scope, direction, and results of scientific discovery could be integrated into human experience. What has become apparent during recent years is that science in and of itself, cannot even justify the basis for asserting a relationship between its empirical facts and truth. Truth cannot be derived from empirical observation, if for no other reason than the limited (in both space and time) perspective of any human observer. For example, science routinely employs causal explanation, but no defense of causality *per se* can be offered by science, or any other empirical explanation. Although David Hume (1777 in: Steinberg, 1977, pp. 50-53) reached the same conclusion over 200 years ago, implications of his critique of an empirical basis for human understanding have not yet become clear to the practitioners of modern science, since so many apparently accept the reductionistic concept that science is the only path to truth.

The naturalist-uniformitarian system cannot reconcile the empirical awareness of human limitations in knowledge with a refusal to allow any place for revelation, or for nonscientific uncertainty in issues rightly belonging to theology or first order philosophy. All knowledge must be subsumed under scientific methodology (see Figure 2 of Part I of Reed, 1996). Therefore science is the naturalist's only hope for truth, but as predicted by the Christian approach, it cannot meet the challenge. The failure of logical positivism to successfully deny distinct yet valid areas of human knowledge outside the positivist's narrow limits has not yet fully penetrated into general scientific consciousness. As it does, the naturalist system must either retreat to mysticism (Schlossberg, 1983, p. 158) or return to a classical western concept of systematic thought of unified truth existing within a multidisciplinary framework. The advent of New Age religions and their associated veneration of nature drives modern man towards mysticism; it is the imperative of Christians to advance a multidisciplinary framework. Either option will effectively end modern post-Christian materialistic naturalism as we currently understand it.

The Role of Outmoded Philosophy in Naturalism

Uniformitarianism did not arise in a vacuum. It was profoundly affected and directed by commitments to philosophical system-building that were characteristic of early modern philosophy. The break between ancient and modern philosophy is commonly attributed to Rene Descartes (1596-1650). One of the distinctive marks of Descartes' work was an emphasis on the rejection of all past thought, and the subsequent necessity for constructing a complete, self-contained philosophical system:

> But since I now wished to devote myself solely to the search for truth, I thought it necessary to do the very opposite and reject as if absolutely false everything in which I could imagine the least doubt, in order to see if I was left believing anything that was entirely indubitable. Thus, because our senses sometimes deceive us, I decided to suppose that nothing was such as they led us to imagine. And since there are men who make mistakes in reasoning, committing logical fallacies concerning the simplest questions in geometry, and because I judged that I was as prone to error as anyone else, I rejected as unsound all the arguments I had previously taken as demonstrative proofs. Lastly, considering that the very thoughts we have while awake may also occur while we sleep without any of them being at the that time true, I resolved to pretend that all the things that had entered my mind were no more true than the illusions of my dreams. But immediately I noticed that as I was trying thus to think everything false, it was necessary that I, who was thinking this, was something. And observing that this truth, *'I am thinking, therefore I exist'* was so firm and sure that all the most extravagant suppositions of the sceptics were incapable of shaking it, I decided that I could accept it without scruple as the first principle of the philosophy I was seeking. (Descartes, R., 1637, in: Nottingham, Stoothoff and Murdoch, 1985, pp. 126-127).

This tendency towards closed, innovative systems was followed through the rationalist school, and to a degree by its critical opponents, and culminated with the constructs of Kant (1724-1804) and Hegel (1770-1831). This drive towards unified systematic truth apart from God spilled over into science. It is no coincidence that uniformitarianism developed on the heels of the golden age of philosophical system building. However, post-modern philosophy has moved in anti-systematic directions, as typified by twentieth century existentialism. Obviously, there now exists a tension between secular philosophy and secular science; a tension that is a direct result of rejection of the biblical Christian worldview by both sides.

However, uniformitarianism as a grand integrating interpretation of earth history has divorced itself from secular philosophy; modern philosophy has turned away from systematic synthesis, but integrated systematic explanations of phenomena are still popular in the earth sciences. Once again, uniformitarianism is trapped by its scientific veneer because of its proponents' inability to perform reflexive criticism and understand their intellectual dependence upon a foundation that is no longer present. The predilection for system-building remains strong in the earth sciences; plate tectonic theory is now heralded as the grand unifying concept of earth history. However, without the ability to provide a philosophical apology for the presumption of being able to unify truth on a grand, systematic scale, uniformitarianism has not only lost step with its biblical Christian roots, but has also, in that respect, been rejected by the secular philosophy that nurtured it in the nineteenth century. Uniformitarianism as a system is now facing external pressures from the secular side that will destroy or radically alter it. It is not apparent that science can survive without some supporting philosophical structure, and no such secular structure appears available.

A rejection of ultimate truth being mediated either through philosophy or science, and a recovery of biblical Christian modes of thought are necessary to reverse current trends in science. However, Christian theology has often followed philosophy in abandoning unifying systematic ventures, as illustrated by the development of theistic existentialism. Unfortunately, an anti-systematic mode of thought hinders theologians (even orthodox ones) from appreciating the significance of the geologic column to theology; they do not think in terms of unifying systems. Recovery of confidence in Christianity's ability to unify truth from all areas of knowledge is crucial to a needed reintroduction of professional Christian theologians and philosophers into the debate about earth history, and the corresponding recovery of science from modern irrationalism.

The University Paradigm

The classical Christian view of knowledge is best described by the "university" (unity in diversity) concept (Sproul, 1984, p. 9). In the "university" concept of Sproul, the ultimate unity of truth allows for divisions of 'labor' in human knowledge and the assignment of particular methods and concerns to distinct areas of interest. Therefore, theology, philosophy, science, history, etc. each have their own independent methods and special questions. Answers to intradisciplinary questions can be confidently integrated on an interdisciplinary level because truth is unified in God. Extreme confidence in the ultimate unity of truth allowed early scientists to pursue piecemeal investigations apart from theological and philosophical justification of each step. This method combined with the empirical tradition derived from the doctrine of creation to form a conceptual framework for modern science (Glover, 1984). However, this process is only possible if an omniscient God exists and if He has revealed truth to rational man created in His image. In the naturalist-uniformitarian system, there is no basis for ultimate truth, there is no basis for man knowing it even if it were there, and there is thus no justification for dis-associated studies reaching unified truth. Yet, this piecemeal pursuit of knowledge is a widely recognized cause for the success of modern science.

The interdependence of the different areas of knowledge also applies to the third dimension of knowledge, and the resulting hierarchical arrangement of disciplines. Disciplines are assigned discrete domains in two dimensions, but can also be conceptualized as relating to each other in the third. Relative positions in this hierarchy of knowledge are based upon each discipline's relative dependence for the justification of its foundational principles. Simply put, the assumptions needed to do science are justified by philosophy, and the foundations of philosophy are justified by theology; therefore science, philosophy, and theology can be conceptualized as a hierarchy of disciplines. The apex of any hierarchy of disciplines in the biblical Christian system is God's revelation, justified by the attributes of God. This hierarchy further defines limits within which special questions and methods of various disciplines apply, and in this structure of knowledge is found one of the most fundamental distinctions between the naturalist and biblical systems.

Because absolute truth and certainty exist in God, and are available in His revelation, human limits to knowledge do not force radical skepticism. Nor is there need to search for indubitable first principles, as did Descartes, in order to justify science. The presence of epistemological human limits are undeniable. While naturalism must by force of logical necessity force these limits to irrationalism, a biblical Christian epistemological framework (culminating in fixed, revelatory truth) allows for the mild skepticism of the empirical tradition, and thus for progress within science. Ultimately, God's revelation justifies science, and science can proceed without the necessity of justifying itself as an autonomous system of thought.

An additional benefit unique to the "university" framework in the biblical Christian perspective is the latitude for tolerance and respect that it provides in intellectual pursuits. This attitude is based on two factors: (1) the recognition that human limits result in a mixture of some error with truth in the work of any person regardless of intellectual ability; and (2) the realization that admixtures of error do not detract from the value of "pieces" of truth in these efforts. Thus, the piecemeal approach to knowledge is not only a function of human limits in terms of the potential scope of knowledge, but also is a function of human limits in terms of the truth of the knowledge existing within the scope of human ability. Recognizing these limits provides a basis for empathy for others that can be exercised because their individual errors do not threaten truth in any ultimate sense, since truth is guaranteed by God, and not by men. Thus in the context of earth history research, anyone operating within the biblical Christian system can exercise tolerance and respect for the work of both those peers operating within the biblical Christian system, and those peers operating within the naturalist-uniformitarian system, and while the naturalist-uniformitarian system is rejected as false on the system level, facets of work done within that system may well demonstrate both astute observation and interpretive insight. This possibility allows the researcher operating in the biblical Christian framework to assess more objectively and accept truth as it exists, even in competing ideological systems.

Mixed Questions and Straight Answers

The biblical alternative to uniformitarian natural history will be distinct because the acceptance of a "university" framework of knowledge, results in the application of a multidisciplinary method, recognizing that no single branch of knowledge is competent for a complete analysis. This approach is consistent with the biblical Christian framework, since truth is expected to be present in all disciplines, and to be consistent between them. Science by itself is inadequate to provide an interpretation of natural history, although there are facets of natural history that require scientific analysis. Similarly theology, philosophy, and history are not individually competent to support a thorough analysis, although each area is crucial to the task. The interpretation of natural history should then be defined as what Adler (1965) has called a "mixed question" A mixed question is one that requires input from more than one discipline. Investigations into earth history must be considered mixed questions, since science alone cannot define unique, non-repeatable historical events or generate metaphysical and epistemological constructs necessary to constrain interpretation. History alone (in the sense of written records and archaeology) cannot investigate and utilize additional physical information contained in the rock record, and is also unable to generate a philosophical framework. Speculative theology, based on biblical revelation provides a framework and justifies methods, but does not provide sufficient detail for interpretation of field data. Only as these disciplines are used together, recognizing the proper limits and relationships of each, can a comprehensive description of earth history be performed.

Christianity contrasts with naturalism by advocating a foundational system that justifies the unity of truth. This system recognizes the pursuit of truth by individual disciplines within their own special spheres, and encourages multidisciplinary approaches to mixed questions. Therefore, biblical creationists should rely explicitly on a comprehensive approach in which they will define and justify a methodology, construct a framework that incorporates applicable areas of knowledge, and define the role of geology in earth history studies. The methodology and scope of the task have been partially defined and justified by the positive aspects of the formal tests presented above. The framework must integrate the roles of theology, philosophy, history, and science (at a minimum), and relate each to revealed truth. At that point, scientific models of stratigraphic interpretation can be offered within the context of the biblical Christian system, and these models can be utilized in field application within the clearly stated context of the entire system. Evaluation of any such stratigraphic model will be twofold: (1) internal tests against the methods and factual constraints of the primary system; and (2) external comparison with field evidence. Any model should include clear criteria for revision or rejection based upon empirical investigation. The great advantage of the biblical Christian epistemological framework is demonstrated by the clearcut implications of failure by a particular geologic model. In the naturalist-uniformitarian system, the failure of the stratigraphic model implies the failure of the system as a whole and forces the possibility of major revisions on a metaphysical level. In the biblical Christian system, the failure of the scientific model implies only the failure of that model; the framework is established within which revision of the failed model or even its replacement can take place in an orderly fashion, allowing for the ongoing progressive, if somewhat irregular, development towards scientific truth.

Another benefit of the biblical Christian system is the capacity for true novelty in scientific discovery. This novelty is possible because the epistemological "anchor" provided by the extrascientific framework allows greater freedom of intellectual risk within science. The failure of any given concept within science does not endanger the underlying epistemological framework. Conversely, such risk is not desirable within uniformitarianism, because it is constrained by possessing practically identical philosophical and scientific limits, and therefore risks ideological loss by empirical failures within its system.

In summary, the epistemological foundation for biblical historical analysis must incorporate several tenets:

- The confidence in the results of science are based on an epistemological division of labor that is possible because God guarantees both the existence and the ultimate unity of truth. The resulting framework allows for the justification of the necessary axioms of science, and for the proper limits on the scope of scientific inquiry.
- The burden on science is proportional because historical analysis can be approached as a mixed question, and science is not driven to perform the tasks of other areas of knowledge.
- The religious significance and resulting potential for subjectivity in historical analysis is not hidden or denied, but faced directly by a system that promotes scientific objectivity by allowing the independent failure of scientific models.

Summary

In Reed (1996) I demonstrated the failure of the naturalist uniformitarian system by its inability to maintain consistency between its fundamental axioms and its methods and conclusions. Conversely, the biblical Christian system meets the test of internal consistency, and thus stands as the superior system in regard to the tests described. In addition, the biblical Christian system offers a consistent epistemological basis for performing earth history analysis by reference to the "university" paradigm of knowing and the derivative mixed question method of investigation.

Naturalism, with its reductionist, scientistic approach to knowledge cannot offer a comprehensive method for earth history studies. In addition to its one-dimensional approach to historical knowledge, naturalism cannot, in its framework of knowing, even offer a possibility of the correspondence between its "knowledge" and truth. Christianity does provide that all important facet by its acknowledged dependence on God as the ultimate arbiter of truth, and on His revelation to men capable of comprehending it (since they are created in His image). Since men are made in God's image, they also possess the intellectual faculties necessary to pursue truth outside of the content of revelation, but within the constraints of revelation. Since the guarantee of truth is found in God, rather than in man, those operating in the biblical Christian system can exercise tolerance and respect for peers operating within competing ideologies.

References

Adler, Mortimer. 1965. The conditions of philosophy. Atheneum Press. New York.

Cottingham, John, Robert Stoothoff, and Dugald Murdoch. Editors. 1985. The philosophical writings of Descartes. Cambridge University Press. Cambridge, England.

Cullmann, Oscar. 1964. Christ and time: The primitive Christian conception of time and history (Third edition, translated by Floyd V. Filson). The Westminster Press. Philadelphia.

Descartes, Rene. 1637. Discourse and Essays. in: Cottingham, John, Robert Stoothoff and Dugald Murdoch, Editors. 1985. The philosophical writings of Descartes. Cambridge University Press. Cambridge, England.

Glover, Willis. 1984. Biblical origins of modern secular culture. Mercer University Press. Macon.

Hume, David. 1777. An enquiry concerning human understanding. Steinberg,. Eric, Editor. 1977. Hackett Publishing Company, Indianapolis.

Medawar, P. B. 1984. The limits of science. Harper and Row, Publishers. New York.

Reed, J. K. 1996. A biblical Christian framework for earth history research part I—critique of the naturalist-uniformitarian system. *Creation Research Society Quarterly* 33:6-12.

Sire, James. 1976. The universe next door. Intervarsity Press. Downers Grove, Illinois.

Sproul, R. C., John Gerstner, and Arthur Lindsley. 1984. Classical apologetics. Academic Books. Grand Rapids.

LETTER TO THE EDITOR

Source of Flood Water

Allen Roy in the June 1966 issue of *CRSQ* (33:18-22), "Fountains of the Great Deep: the Primary Cause of the Flood," has made a notable contribution to Biblical creationism in providing exegetical support for a Flood model that provides an adequate source of water in accord with basic principles of science.

The description of planet Earth's surface at the beginning of the Creation Account represents maximum stability, "infinite age" features—minimum potential energy, low profile that placed the entire surface underwater, maximum entropy. On the third day of Creation Week continental surfaces were raised (and dried), and the remainder of the global surface relatively depressed to provide ocean basins. This change was an act of creation that required a vast input of potential energy, with attendant reduction in entropy. It was a reversal of "natural" processes that may be compared to the reversal of natural processes when the dead body of Lazarus was converted into a functioning healthy young man. [In using this illustration I do *not* wish to imply that at some remote time prior to Creation Week there were dry-land continents on planet Earth.]

The Biblical record specifies that heavy rain was a distinguishing feature of the Flood experience; but this specification does not require all the rise in water from prior sea level to 20 feet above the highest mountain (Gen. 7:20) to have been rainfall. From the first 10 verses of Genesis we can model the initial stages of the Flood as a reversal of the Earth-surface changes that occurred at the beginning of the third day of Creation Week. At the height of the Flood the entire surface of the planet was covered with water, as it had been at the beginning of Creation Week.

At the height of the Flood the planet was again in the most stable, maximum entropy, configuration. The potential energy in the pre-Flood surface profile of elevation and depression had been converted into heat and dissipated. The termination of the Flood required reintroduction of potential energy, and was an act of creation similar to the formation of dry-land continents on the third day of Creation Week. In contrast with the original creation of continents in less than one day, the termination of the Flood was extended over nearly eight months, and probably continued in exponentially-decreasing continental uplift over decades and centuries following.

To satisfactorily model the Flood it is not necessary to postulate original creation of water for the necessary amount of rainfall, or release of unreasonable amounts of ground water from soil, rock, and underground cavities. An adequate amount of water is indicated in the second verse of Genesis. [See word studies of the Hebrew terms translated "deep" and "waters."]

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Quote — Textbooks and Pure Fancy

A large number of well-trained scientists outside of evolutionary biology and paleontology have unfortunately gotten the idea that the fossil record is far more Darwinian than it is. This probably comes from the oversimplification inevitable in secondary sources: low-level textbooks, semipopular articles, and so on. Also, there is probably some wishful thinking involved. In the years after Darwin, his advocates hoped to find predictable progressions. In general, these have not been found—yet the optimism has died hard, and some pure fancy has crept into textbooks.

Raup, David M. 1981. Evolution and the fossil record. *Science* 213:289.

THE ENIGMA OF SEX AND EVOLUTION

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Abstract

A severe problem for evolution theory is to explain the evolution of sexual reproduction and behavior. The theories proposed include dual evolution, i.e., the sexes evolved separately but greatly influenced each other's evolution. Another major theory is sexual selection, a process by which organisms directly influence each other's evolution. The creationist model proposes that the sexes were designed to be physically and mentally compatible with each other, and for humans a harmonious physical and mental relationship will result if the couple live in harmony with the physical and mental constraints of this design.

Introduction

Evolutionary naturalism hypothesizes that life originally reproduced by a process of fission somewhat similar to how normal cells divide today. Life later evolved a more complex system of reproduction called asexual. This involved each animal or plant producing *both* eggs and sperm, so they could self-fertilize. Even later a yet more complex system of reproduction called **sexual dimorphism** evolved. This system required two physically distinct sexes, male and female, in order to produce offspring (Crook, 1972, pp. 233-235).

Sexual reproduction requires that the sperm, typically from the male, be transferred to the female in order to fertilize the eggs thus forming zygotes. Another method of sexual fertilization involves the male depositing sperm directly on the eggs previously laid by the female the technique used by many kinds of fish. Evolutionists have usually assumed that sexual reproduction evolved because it somehow facilitates survival in the Darwinian sense (Gibbons, 1991, pp. 957-958). Even our notion of physical sexual attraction and beauty, it is argued, must be adaptive in a Darwinian sense. A whole new science field has developed from this view which examines "beauty through the prism of Darwinism" (Concar, 1995, p. 40).

Evolution also must explain the many varieties of sexual dimorphism—a common example is the brightly colored feathers found in members of one sex and the dull color that commonly exists in members of the other sex. All of the many other sexual forms also must be explained by evolution. For example, among both ants and bees there exist two different kinds of females—the workers and the fertile queen—and also several kinds of males (Klotz, 1970, p. 184). A related concern is **sexual selection,** whereby potential mates are theorized to have produced the many sexual differences existing in nature. In most animals "males are predominant competitors for mates, but in a few species, females compete more intensely for mates" (Clutton-Brock and Parker, 1992, p. 438).

The Importance of the Origin of Sex

The issue of the origin of the X and Y chromosomes, the many physical and psychological sexual differences, plus the whole problem of sexual reproduction "represents the most important challenge to the modern theory of evolution" (Bell, 1982, book jacket). As Margulis and Sagan (1986, p.203) conclude, the origin of sex involves "a large and varied set of different problems . . . not easily amenable to unitary mathematical treatment" Efforts to understand the phenomenon have failed to such a degree that

> sex is the queen of problems in evolutionary biology. Perhaps no other natural phenomenon has aroused so much interest; certainly none has sowed as much confusion. The insights of Darwin and Mendel, which illuminate so many mysteries, have so far failed to shed more than a dim and wavering light on the central mystery of sexuality. . . . It seems that some of the most fundamental questions in evolutionary biology have scarcely ever been asked (Bell, 1982, p. 19).

In an attempt to respond to what Bell considered the failure of the leading researchers in this area, including George Williams, Michael Ghiselin, and John Maynard Smith, he completed a massive study while still

> a member of the ecology group at McGill, and could not have chosen a better place [to do this research]. Since the group includes two convinced and (worse) logical anti-Darwinists I soon found that I could not get away with the deplorably loose reasoning of much evolutionary theory, and was forced to adopt a much more respectful attitude to facts and a much less respectful attitude to theories (Bell, 1982, p. 17).

Bell concluded that this subject is far more complex, and it is far more difficult to arrive at a theory that supports evolutionary naturalism than previous researchers had assumed (see Trivers, 1983 for an excellent review of Bell). This lack of knowledge has not prevented many biologists from justifying what many today believe are unacceptable conclusions, such as the inferiority of women doctrine which developed partly because evolutionary naturalism seemed to require it (Symons, 1980, pp. 21-28; Tanner and Zihlman, 1976, pp. 585-608).

The Putative Evolution of Sexual Dimorphism

The three major explanations for the evolution of sexual dimorphism are sexual selection, intraspecific niche divergence. and ecological competition (Shine, 1989, pp. 419-421). Its origin is an important question because major sexual dimorphism is universal in most animal phyla. Although admitting that the environment cannot be totally discounted, Fisher, following Darwin, tried to explain almost all physical and behavioral sexual dimorphism differences existing in the sexes as the

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result of sexual selection. This includes not only hunting skills and obvious secondary sexual characteristics, but also the high female voice and her ability to produce song which

> like small body size, the higher female voice seemed childlike, unthreatening, more sexually attractive. If so, those who retain high pitch at puberty made more desirable mates. Darwin agrees. In *The Descent of Man* he says that the first females used their high voices as musical instruments and . . . we may infer that they first acquired musical powers in order to attract the other sex (Fisher, 1982, p. 97).

One might wonder just how critical a high voice is in sexual attraction, and why this would be valued. We today are used to the high voice of females, but overall it would seem to be a minor factor even in cultures that have come to value this trait. Fisher also concludes that sexual selection evolved males that were "good hunters and dependable providers . . . those that could get along with other males and had self-confident, alert, amiable, popular personalities . . . [and also] large, strong males must have been in demand, too, because men are on the average 20% larger than women—a sexual dimorphism apparent in humans around the world" (Fisher, 1982 p. 96). Others have argued that women are evolutionarily superior (Montagu, 1952; Tavris, 1992). Sexual reproduction still does not explain sexual dimorphism; and

> another baffling and subtle problem [is]—if sex, why sexes? If recombination, the shuffling together of the genetic material of two individuals, is such a good thing, why has evolution not come up with a scheme which allows everyone to mate with everyone else? As we are limited in our choice of partners to those of a different sex, having just two sexes seems to be very inefficient. Nearly all organisms (with the exception of a few single-celled creatures which have up to six sexes) exist as just males and females. This means that only half the population is available as a potential mate (Jones, 1993, p. 88).

The Role of Sexual Selection in Evolution

One of the cornerstones of Darwinian evolution is *sexual selection.* This theory postulates that some evolution results partly from the hypothesized tendency of animals to preferentially select mates with certain traits. Selection thus favors the increase of certain traits, both those that the animal interprets as attractive and those which encourage mating. Applied to humans, the theory concludes that women with certain traits—slimness, certain nose shape, etc., would be more apt to be selected, thus a greater and greater percent of women with these traits would marry and consequently would pass them on to their offspring. The evidence for this factor is probably in general greatest among humans because we are, by far, the fussiest of all living creatures in mate selection (Reed, 1975, pp. 273-333). Yet, no direct evidence of any evolution of sexual traits due to sexual selection exists in human history (Kropotkin, 1972).

It was at one time hypothesized that men desire certain traits in women—the slender figure of certain proportions is the most salient of these—and men thus were more likely to marry those women with these traits. Yet weight, especially in western females, is far more of a problem today than ever before, and no evidence exists that the genetic factors that affect size and body proportions of women have changed significantly since before 2,000 BC when useful data is available. Whatever changes have occurred are due to cultural and diet changes.

Many animals show primarily a mate selection preference for their own species, and many show even less sexual selection. Among humans, about 95% of all people in Western society eventually marry by age 50 (U.S. Bureau of Census, 1995) and of those who do not, many have children (and many more at least attempt to) in their lifetime. Further, many of those who do not marry are involved in religious orders, occupations or pursuits such as the military, all of which select on the basis of desirable physical and mental characteristics, including health, intelligence and integrity. Some of the most unlikely candidates marry and father children. Many of the more desirable women enter careers such as modeling, or marry into the higher socioeconomic status and for various reasons give birth to fewer children than average (Fisher, 1979, pp. 219-224). A negative correlation for this reason tends to exist when family size is compared with educational level, socioeconomic status, intelligence, and occupational prestige.

Although sexual selection is evidently more powerful among humans than almost all animals, we show little evidence of it. In Jones' (1993, p. 92) words "There is little evidence (in spite of much prurient speculation about beards, breasts and buttocks) that humans have attributes of this kind" because of sexual selection. In addition, sexual selection based on a preference for attractive mates would serve to *reduce* physical differences among humankind.

Even though Darwin's theory of sexual selection was a major cornerstone of his evolution theory, many well known scientists have never accepted it. Rice (1925, p. 245) states, "sexual selection is relegated by many to the rank of a somewhat doubtful hypothesis rather than theory." Smith (1978, pp. 2-18) even concludes that Darwin's sexual selection idea now receives *little* attention from contemporary biologists. He also claims that in *no case* has it been scientifically demonstrated that such selection in wild populations has significantly changed an animal. This is not surprising, since it would be necessary to show not only that the females selected some kinds of males in preference to others, but also as a result of so choosing, certain females on the average produced a larger number of offspring.

A far better case exists for the argument that sexual selection functions as a means of *reducing* the number of unfit, the deformed and the clear "monsters," of the species. Some sexual selection does occur, but an argument exists that sexual selection at most reduces *disgenics* or *de-evolution.* This is partly because most young, healthy animals of the same species look much the same. Other than the owner and close associates, most observers have a difficult time distinguishing one adult German Shepherd from another. Aside from certain neutral identifying spots on their fur and hair color variations, they are largely identical. More physical trait variation exists in humans than in most animals, and most animals are far less fussy in mate selection then humans (Allee, 1938; Williams, 1977, pp. 124-134). Many animals, both tame and wild, regularly try to mate with a wide variety of animals with which they cannot produce offspring (Smith, 1978). Dogs often try to mate with a wide variety of dogs, even those that seem unlikely candidates. In Williams's (1974, pp. 184-185) words, "The greater promiscuity of the male and greater caution and discrimination of the female is found in animals generally."

Although sexual selection "is an important component in the mating system of a variety of species," it can select only for traits that exist and for which it is programmed to select (McLennan and Brooks, 1991, p. 255). Selection cannot occur without the inborn preference for certain traits, and both the traits selected for and the behavioral mechanism that does the selecting are evidence of design. The evidence is that sexual selection primarily only fine tunes, or reduces de-evolution. Hundreds of examples of this exist (Bergman, 1993, pp. 93-106).

Sexual selection, as does natural selection, therefore probably plays largely a *conservative* role in evolution. Numerous studies have found that animals which deviate in a significant way from the norm are more likely to be weeded out (Ambrose, 1982). The origin of the behavioral component called **sexual drive** is critical in sexual selection. For example, Cambridge University zoologist, Charles Goodhart claims that humanity "lost" its fur coat and became a "naked ape" before the start of the last ice age between 70 and 120 thousand years ago (1993, p. 4). He concludes that this occurred because of sexual selection in spite of the temperature changes which would select for a fur coat. Specifically, males came to prefer hairless women. Consequently, he argues, the trait of hairlessness was selected for both sexes. He adds that even today men prefer women lacking beards, mustaches, or excessive body hair. Goodhart cannot explain how these pre-humans, the most evolved form of life then, were so successful at reproducing and yet males somehow developed a preference for hairless females. He adds that hairlessness was a very rare trait then and a preference that did not exist among any other mammals including primates.

How this behavioral preference developed cannot be explained, a problem because this change supposedly occurred *before* the ice age when a thick coat of hair would be critically important for survival. Presumably the behavioral preference for hairlessness developed because of sexual selection—yet this preference would be selected *against* by the coming ice age. Also our hypothetical ancestors are universally regarded as extremely hairy, and for this reason those with the sexual drive for hairy females would be more likely to reproduce; thus this drive would be selected.

Presumably a loss mutation caused the disappearance of most of the body hair, and hairless apes were more sexually attractive, thus disproportionally were selected. Why this preference developed cannot be explained, especially since we see no evidence that any primate prefers hairlessness. The opposite extreme in human hair growth called **hirsute** is well known. This entire scenario is highly speculative and totally lacks empirical support. It is a post-hoc scenario that tries to explain the uniqueness of humans in contrast to all other primates.

Numerous studies have found that the sexual selection that does occur is strongly related to the health of the animal selected. Consequently, the healthy are far more apt to be selected (McLennan and Brooks, 1991, pp. 255-286). This is often true even regarding minor morphological deviations. One example is the research that found male Japanese scorpion flies with the most symmetrical wings won the most mates (Concar, 1995, pp. 40-44). As another example Mollen found he could "ruin male swallows' chances of finding mates merely by making their tails less symmetric" (Concar, 1995, p. 41). Research with humans has found the most desirable traits are generally an average of existing traits. When the faces of women were computer averaged, the composite was judged more attractive by a group of adults then any of the persons in the individual pictures. And the more faces used in making the computer image, the more appealing it was judged by adult judges (Jones, 1993, p. 95).

Ramifications of the Origins of Sex Question

The origins of sex question is important because it has critical implications for behavior standards and social policy. An example is Wright's conclusion that evolution has shaped our genes so that "it is to a man's evolutionary advantage to sow his seeds far and wide" and that women should seek mates with "the best genes and the most to invest in offspring" (Wright, 1994, p. 45). In other words, Wright argues that evolution would select for promiscuity in males because this behavioral trait would enable them to produce more offspring—and consequently it would be more likely that these genes would be passed on.

The reasoning is, if a mutation occurs which enables a male to be more sexually aggressive and promiscuous, this gene then would be positively differentially selected. Males who are sexually aggressive and promiscuous are more apt to leave offspring, thus are more likely to pass that gene on to their greater number of offspring. Conversely, it is to a woman's benefit, he argues, to seek a mate who is going to provide security and will insure that the children she has are more likely to survive. Evolution would for this reason select for those traits. This common scenario is frequently presented in both the scholarly and the popular literature.

Little historical or empirical evidence exists for this position, and the same reasoning that applies to men *also* could apply to women. Women who are highly promiscuous are also likely to have more offspring, thus are more likely to pass on their promiscuous genes. On the other hand, the analogy used to explain women's lack of sexual aggression and promiscuity could also be applied to men, i.e., a man who seeks a woman who is able to bear and properly raise his children will have offspring that are more likely to survive to pass on his genetic desire for a woman who is able to bear and effectively raise his children (Reed, 1975). The evolutionary theory seems more a post-hoc explanation to justify irresponsible male behavior and a dual sexual standard (Kevles, 1986; Hubbard, 1979; Morgan, 1972; Borgese, 1963). Darwin originally argued along those lines, specifically concluding that males usually have larger bodies due to an advantage for male to male combat for females (Shine, 1989, pp. 419-461). Many of the conclusions about humans come from observing animals, a practice that is fraught with difficulties:

> The Nobel Prize-winning behaviorist Konrad Lorenz saw humans as "killer apes" anxious to pass on our own genes by murdering the opposition, which may have explained his own early flirtation with the Nazis; and any decent airport has a row of paperbacks whose embossed covers purport to explain human nature as emerging from a history as primates with one or other sexual and social preference (Jones, 1993, p. 91).

The major problem with sexual selection is that natural selection would select against sexual selection. Mates who are choosy about their mates are less likely to mate, and less likely to pass on their traits to their offspring. Sexual selection would select for those who do not discriminate on the basis of irrelevant physical traits—and those who do not discriminate at all are far more apt to leave offspring. Clearly, sexual selection would favor those individuals who are not sexually selective, a major factor which would work against sexual selection.

The Evolution of Sex from Asexual Reproduction

The lack of evidence of any biological systems that can bridge the chasm between sexual and asexual reproduction either today or in the past is also a major difficulty with evolution theory. Actually, the complete lack of any transitional forms for all sexual traits is a huge major fossil gap. The same problem also exists here as with any transitional form: structures are useless or worse until they are at least marginally functional. This is *especially* true regarding reproduction, and would result in rapid extinction if the features produced by mutations were less then fully functional (Hrdy, 1981, pp. 25 and 150).

The complete lack of transitional forms bridging asexual cellular fission from the more complex asexual and sexual reproduction is not explained but confounded by the fact that some plants and simple animals can reproduce *both* sexually and asexually. The forms of life that can reproduce effectively by *either* system are not in any sense intermediate but are comparable to an animal with equally effective gills and lungs. To be able effectively to reproduce *both* sexually and asexually would confer upon the organism an enormous evolutionary advantage: its genes could be passed on *regardless* of whether a mate was available. Indeed, considering that a key to evolution is reproduction efficiency and high numbers of offspring, evolutionary naturalism would predict the development of *both* highly developed sexual and asexual reproductive systems in the same plant or animal.

The History of the Problem of the Origin of Sex

Darwin also recognized the origin of sex problem as a major difficulty for evolutionary naturalism. In spite of 100 years of research, the problem is more serious today because of our vastly greater knowledge about the enormous complexity of sexual behavior and physiology. In Williams' (1977, p. 124) words "the masculine-feminine contrast is a *prima facie* difficulty for evolutionary theory." His is a far more honest appraisal than the usually simplistic theories based on hypothetical natural selection events. While these events may function to reduce de-evolution, the claim that natural selection is the *creator* is a claim plagued with major problems.

Evolution requires sexual reproduction to have evolved from asexual reproduction via natural selection; thus, this more evolved reproductive method must confer clear evolutionary advantages. Researchers must, therefore, accept this conclusion *a priori* and attempt to defend it, no easy matter as researchers in the field have conceded. The enormous disagreement in the field also shows just how tenuous are the conclusions used to support the assumptions of sexual evolution (Sherfey, 1973). Williams conceded that comparing the parthenogenetic reproduction of diploid eggs of the parental genotype to the genetically diverse haploid eggs that require fertilization reveals "that the parthenogenetic individual has twice the fitness of the sexual" (Williams, 1977, p. 8). He concluded that "this immediate advantage of asexual reproduction is generally conceded by all those who seriously concerned themselves with the problem" (Williams, 1977, p. 8).

Evolution theory argues that sexual reproduction was selected because it produces offspring of greater variety, thus allowing future evolution forces more from which to select (Sheppard, 1963). Greater variety is a goal which is admittedly critical or life. This fact, though, does not explain the origin of sex, especially the severe problem of how animals were able to reproduce before the evolution of the many complex physiological and psychological mechanisms which cause sexual behavior. Field studies, especially on organisms that reproduce both sexually and asexually, have found that "they usually reproduce asexually, but use sexual reproduction in special situations . . . sex is an adaptation to special situations" (Williams, 1977, p. 3). In other words, evolution does not select for sexual behavior as opposed to asexual, but sexual reproduction is a mechanism with certain advantages in some situations.

A comparable example are the human hands which are capable of accomplishing complex tasks like painting, drawing, or writing. They are critical in certain situations and tasks, yet the feet are commonly used for other tasks and are enormously superior for certain things, such as locomotion. The evolutionary trend is not to lose feet and evolve hands because hands have a clear advantage in some situations, but both are useful. Likewise, both sexual and asexual reproduction are an important part of the overall functioning and survival of life.

Actually, comparisons between asexual and sexual reveal that asexual reproduction is in many ways superior from an evolutionary standpoint. Asexual reproduction produces both a larger initial offspring number and more sets of offspring than sexual, whose offspring are few in number and typically produced only once a season. To balance this loss, the mortality rate is often high for asexual reproduction and low for sexual reproduction. The offspring from asexual reproduction also typically develops and matures rapidly after birth. Especially the higher forms of sexual development also often require the organism to progress through more or longer developmental stages (Williams, 1974, pp. 87-91; 1977, pp. 57-60).

Since asexual reproduction also has the advantage of producing far more offspring, it may provide evolution much more to select from compared to sexual. Further, the offspring are far less vulnerable because they skip or rapidly progress through the infant or larval stages when animals are usually poorly able to defend themselves. The brief reproduction period and few offspring for sexual reproduction produces such clear disadvantages that Bonner (1958, p. 193) seriously asked "what use is sex" to evolution, and consequently why would it evolve? Researchers have, for these reasons, struggled to delineate why natural selection would evolve sexual behavior in view of the fact that asexual reproduction seems to be far more advantageous from an evolutionary standpoint. Jones claims that sex exists because:

> . . . if a sexless organism has a harmful change to the DNA, it will be carried by all her descendants. None of them can ever get rid of it, however destructive it might be, unless it is reversed by another change in the same gene-which is unlikely to happen. In time, another damaging error will occur in a different gene in the family line. A decay of the genetic message will set in as one generation succeeds another, just like the decay that takes place within our aging bodies as our cells divide without benefit of sex. In a sexual creature the new mutation can be purged as it passes to some descendant but not others (1993, p. 86)

The problem with this conclusion is that a harmful or lethal mutation causes the entire line to die out, purging it forever from the population while millions of other lines carry on. With sex, because most mutations are recessive, many mutations that are not lethal are spread to the race in general. Problems result *only* if the same defect is inherited from both parents thus the harmful traits can accumulate in the race. With asexual animals the weaker lines are rapidly selected out, often in one generation.

Exceptions to these differences between sexual and asexual reproduction exist, but the generalizations noted above are the rule. The many researchers who have attempted to answer the question "what use is sex" for evolution have found a very limited level of support. Many of these explanations are *ad hoc* and ignore the major problem that sex does not provide an evolutionary advantage until the system is perfected—a topic which few have attempted to address, and those who have must rely on enormous speculations. The speculation in this field, Williams admits, is such that many researchers reason from a set of premises to a conclusion by knowing the conclusion in advance (1977, p. 6). He adds that the task of determining why sexual reproduction evolved seems "immensely difficult . . . because we can immediately see an enormous disadvantage in sexual reproduction" (pp. 155-169).

The data can be explained far better if we substitute for the evolutionary hypothesis the concept that the two different means of reproduction are not unlike the two basic human appendage types, the hands and the feet. As the hands are clearly superior in some situations, the feet in others, likewise asexual reproduction is a superior method for many kinds of animals, especially the so-called simple forms such as bacteria. Conversely, sexual reproduction is superior for other life forms, such as mammals and chordates in general. It would be impossible for bacteria to fulfill their critical ecological role of recycling if they reproduced sexually. Further, bacteria possess the advantages of *both* asexual and sexual reproduction by being able to exchange genes via plasmid transfer.

The major problem with the evolution of sexual reproduction is that for most traits:

> at least one male and one female of a 'new mutant' would have to appear at the same time and in the same breeding community, in a bisexually reproducing organism, for the new type to persist (Sheppard, 1963, p. 239).

The major source of new traits for evolution to select from, according to the standard model, is mutation, although genetic drift, isolation, population size and other factors all play a small role. Most mutations known today are recessive and the larger the change the mutation causes, the more likely that it will be harmful (Sheppard, 1963, p. 239). Although thought experiments can be carried out with beneficial mutations, we have no empirical evidence from which to evaluate this event because we have no clear example to examine. In the words of Rust, "Not even a single 'positive' or adaptive mutation, in the sense of an improved function previously unavailable, has been documented in any organism" (Rust, 1992, p. 86).

Although evolution requires that sexual reproduction be strongly favored, animals that reproduce sexually are usually at the *bottom* end of the evolutionary hierarchy in terms of reproductive success. Further, major evolutionary development must have occurred in the sexually reproducing populations since they are the ones that are evolutionarily a long distance from the more simple so-called primitive life forms such as yeast and bacteria. Mutations have been produced in sexual organisms by irradiating the zygote or the gametes, but they either damage only *one* of the typical pair of genes that exist for a trait, or if both, the damage often will not affect the phenotype unless they are a dominant gene (Eberhard, 1985).

Whether a mutation is harmful depends on if it affects a dominant, or mixed dominant gene. The clear advantage of a pair of genes typical of all sexually reproducing organisms is why mutations have less effect. Bacteria have only one chromosome and do not have matched gene pairs. This is why they often dominate contemporary genetic work, especially in the recombinant DNA area and with other genetic manipulation techniques.

Most known mutations are recessive, meaning only some of the proteins they produce are non-functional in contrast to the dominant which produce *all* defective protein. For most mutations, enough functional protein can for this reason usually be manufactured, or the trait the gene codes for will exist because enough functional protein is produced by the normal gene. No documented cases exist of a beneficial mutation occurring simultaneously on *both* a gene and its corresponding allele. If a beneficial mutation occurred, presumably it would be on a heterozygous dominant gene, and the protein which was produced before this mutation existed would now no longer be manufactured by the organism. Conversely, the majority of mutations in non-dominant genes which do not produce the normal protein would always, or at least in many cases, have a detrimental effect.

Therefore, although the situation with bisexual reproduction is more complex than Sheppard indicates above, postulating evolutionary change on the basis of mutations is fraught with difficulties. He adds that "moreover, such a small population as a single pair [with the mutation] will have little chance of surviving" (1963, p. 329). On the other hand, asexual reproduction allows mutations to be passed directly on to their offspring. If a mutation that was clearly beneficial occurred, its advantage would be immediate, and thus would result in a rapid increase in the number of the offspring with the advantage. This commonly has been observed in bacteria when a favorable strain rapidly takes over in an environment which is hostile to other strains. In conclusion, Williams' extensive survey of the literature appears to be valid:

> The problem has been examined by some of the most distinguished of evolutionary theorists, but they have either failed to find any reproductive advantage in sexual reproduction, or have merely showed the formal possibility of weak advantages that would probably not be adequate to balance even modest recombinational load. Nothing remotely approaching an advantage that could balance the cost of meiosis has been suggested. The impossibility of sex being an immediate reproductive adaptation in higher organisms would seem to be as firmly established a conclusion as can be found in current evolutionary thought. (Williams, 1977, p. 11)

Yet, as Williams notes, if evolution is true, this conclusion "must surely be wrong" because asexual reproduction must have evolved first, and "lower" organisms still usually reproduce asexually and the higher, more evolved organisms reproduce sexually. The problem is primarily due to flaws in the basic evolutionary assumptions.

The Creationist Explanation

The creationist explanation for sex and sexual dimorphism is that it is part of the Creator's design for life. The male and female reproductive systems are physically and chemically harmonious, and this complex system, creationists argue, must have been designed simultaneously as *a unit* to be physically compatible. Likewise all the other sexual differences exist to enable the sexes to carry out their God designed role. Evolutionists must postulate that far more primitive systems once existed in evolutionary history that lacked all or most of these structures, and yet were able to function successfully. This would allow survival of the species and enable the organism to survive its main competitors. It is so difficult to hypothesize these proto-sexual structures that most evolutionists have not even tried, and those that have recognize the enormous problems in doing so (Williams, 1977). Like engine and car body units that are designed to be functionally integrated, the male and female sexual reproductive system likewise must have been designed as a unit. Creationism can also answer Jones challenge:

> Biologists have an adolescent fascination with sex. Like teenagers, they are embarrassed by the subject because of their ignorance. What sex is, why it evolved and how it works are the biggest unsolved problems in biology. Sex must be important as it is so expensive. If some creatures can manage with just females, so that every individual produces copies of herself, why do so many bother with males? A female who gave them up might be able to produce twice as many daughters as before; and they would carry all her genes. Instead, a sexual female wastes time, first in finding a mate and then in producing sons who carry only half of her inheritance. We are still not certain why males exist; and why, if we must have them at all, nature needs so many. Surely, one or two would be enough to impregnate all the females but, with few exceptions, the ratio of males to females remains stubbornly equal throughout the living world (Jones, 1993, p. 84)

Summary

The problem of the evolution of sexual anatomy and physiology and behavior from the more "primitive" asexual and simple cellular division was recognized as a major problem for naturalistic evolution from the very beginning of Darwinism. Evolution is totally inadequate to explain why males exist, although researchers as Jones have tried to come up with plausible explanations. Creationism, though, provides a clear explanation: sexuality exists because it is part of God's plan for humans and other organisms. Evolution focuses on survival only, God focuses on what is good for human happiness and His purposes for the universe. Why sex exists is rarely discussed even in works devoted to the evolution of sex, and it still remains a major problem in evolutionary theory (Ford, 1980, pp. 13-24). Works that purportedly discuss the evolution of sex largely cover only limited aspects of sexual selection, the putative advantages of asexual versus sexual reproduction and other concerns related to microevolution (Hapgood, 1979).

A reason for the lack of evidence is because it was alleged that the fossil record rarely preserved soft body parts; thus, ancient gonads and secondary sexual characteristics rarely can be studied. This is now known to be false, and a huge number of soft parts or their fossil impressions have been preserved in such places as the Burgess shale or on animals preserved in amber, tar pits, coal and other mediums.

Secondly, it is difficult even to speculate on the possible evolution of the gonads and the sexual reproductive system from the simple binary fission reproduction method. Obviously, binary fission must have continued for the animal to survive while the sexual system of reproduction was evolving. Problematic with this theory, though, is that it would not be selected for until it was highly functional and effectively could reproduce in ways superior to binary fission. A major concern for natural selection theory is that asexual and sexual reproduction are simply two means of reproducing, and one is not necessarily superior to the other, especially by evolutionary criteria. From an evolutionary standpoint, fission is in many ways superior relative to the number of offspring which allows a greater amount of selection to occur, and consequently causing a greater level of evolution. This is contrary to what evolution predicts, and it is apparent for these reasons that the creation explanation is superior.

References

CRSQ-Creation Research Society Quarterly.
Allee, W. C. 1938. The social life of animals. Bacon Hill Press. Boston.
Ambrose, E. J. 1982. The nature and origin of the biological world. Wiley, Halsted. New York.
Bell, G. 1982. The masterpiece of nature; The evolution and genetics of sexuality. University of California Press. Berkeley.
Bergman, J. 1993. The Problem of extinction and natural selection. *CRSQ* 30:93-106.
Bonner, J. T 1958. The relation of spore formation to recombination. *American Naturalist* 92:193-200.
Borgese, E. M. 1963. Ascent of women. Braziller. New York.
Campbell, B. Editor. 1972. Sexual selection and the descent of man, 1871-1971. Aldine. New York.
Clutton-Brock, T. H. and G. A. Parker. 1992. Potential reproduction rates and the operation of sexual selection. *The Quarterly Review of Biology* 67(4):437-456.
Concar, D. 1995. Sex and the symmetrical body. *New Scientist* 146:40-44.
Crook, J. H. 1972. Sexual selection, dimorphism, and social organization in the Primates. In Campbell, B. Editor. 1972. Sexual selection and the descent of man 1871-1971. Aldine. New York.
Darwin, C. 1859. The origin of species by means of natural selection. D. Appleton. New York (1897 edition).
__________. 1871. The descent of man and selection in relation to sex. D. Appleton. New York 1896 edition.
Eberhard, W. G. 1985. Sexual selection and animal genitalia. Harvard University Press. Cambridge. MA.
Fisher, E. 1979. Woman's creation; sexual evolution and the shaping of society. Anchor Press / Doubleday. Garden City. New York.
Fisher, H. E. 1982. The sex contract: The evolution of human behavior. William Morrow. New York.
Ford, B. J. 1980. Patterns of sex: The mating urge and our sexual future. St. Martin's Press. New York.
Ghiselin, M. T. 1974. The economy of nature and the evolution of sex. University of California Press. Berkeley.
Gibbons, A. 1991. The brain as "sexual organ." *Science* 253:957-958.
Goodhart, Charles. 1993. In Penman, D. Editor. "Man Shed Fur Coat in Days Before Last Ice Age." *The Independent of London* 48 (3):4.
Hapgood, F. 1979. Why males exist: An inquiry into the evolution of sex. William Morrow. New York.
Hole, J. W. 1993. Anatomy and physiology. William C. Brown. Dubuque, IA.
Hrdy, S. B. 1981. The woman that never evolved. Harvard University Press. Cambridge, MA.
Hubbard, R. 1979. Have only men evolved? In Hubbard, R., M. Henifin and B. Fried. Editors, Women look at biology looking at women. G. K. Hall. Boston, pp. xv, 7-35.
Jones, S. 1993. The language of genes. Bantam Doubleday. New York.
Kevles, B. 1986. Females of the species; sex and survival in the animal kingdom. Harvard University Press. Cambridge, MA.
Klotz, J. W. 1970. Genes, genesis and evolution. Concordia Publishing. St. Louis, MO.
Kropotkin, P. 1972. Mutual aid. New York University Press. New York.
Margulis, L. and D. Sagan. 1986. Origins of sex; three billion years of genetic recombination. Yale University Press. New Haven.
McLennan, D. and D. R. Brooks. 1991. Parasites and sexual selection: macroevolutionary perspective." *Quarterly Review of Biology* 66(3):255.
Montagu, A. 1952. The natural superiority of women. Lancer Books. New York.
Morgan, E. 1972. The descent of woman. Stein and Day. New York.
Reed, E. 1975. Woman's evolution: From matriarchal clan to patriarchal family. Pathfinder Press. New York.
Rice. E. L. 1925. Darwin and Bryan—A study in method. *Science* 61:243-250.
Rust, P. 1992. How has life and its diversity been produced? *Perspectives on Science and Christian Faith* 44(2):88-94.
Sheppard, P. M. 1963. Evolution in bisexually reproducing organisms. In Huxley. J. A. C. Hardy and E. B. Ford. Editors. Evolution as a process. Collier. New York. pp. 237-256.
Sherfey, M. J. 1973. The nature and evolution of female sexuality. Vintage. New York.
Shine. R. 1989. Ecological causes for the evolution of sexual dimorphism: A review of the evidence. *The Quarterly Review of Biology* 64(4):419-461.
Smith, J. M. 1978. The evolution of sex. Cambridge University Press. Cambridge.
Symons, D. 1980. The evolution of human sexuality. Oxford University Press. New York.
Tanner, N. and A. Zihlman. 1976. Women in evolution. Part I: Innovation and selection in human origins. *Signs: Journal* of *Women in Culture and Society* 1(3):585 608.
Tavris, C. 1992. The mismeasure of women: Why women are not the better sex, the inferior sex, or the opposite sex. Simon and Schuster. New York.
Trivers, R. 1983. The evolution of sex; A review of the masterpiece of nature: the evolution and genetics of sexuality. Bell, G. Editor. *The Quarterly Review* of *Biology* 58:62-67.
Williams, G. 1974. Adaptation and natural selection. Princeton University Press. New Jersey.
__________ 1977. Sex and evolution. Princeton University Press. New Jersey.
Wright, R. 1994. Our cheating hearts. *Time* 144(7):44-52.

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PANORAMA NOTE

The Return of Lake Manly, Death Valley, California?

Introduction

Past climatic conditions associated with the desert southwest of the United States have fascinated scientists for many years. Most interesting are the wet-weather conditions associated with the uniformitarian Pleistocene Epoch, which correspond to the Young-Earth Flood Model single Ice Age (Oard, 1990; Froede, 1995). Both models suggest that wet-weather conditions created large freshwater lakes in many of the bolsons (i.e., basins) between the intervening ridges of the Basin and Range Province (Dawson, 1992, pp. 134-138; Fiero, 1986, p. 172; Flint, 1971, pp. 446-448; Hunt, 1975, pp. 11-14; Morrison, 1965, pp. 278-280; Oard, 1990, pp. 78-80). Pluvial/Post-Flood lakes have also been discussed in other works by creationists (e.g., Austin, 1994: Coffin, 1983; Holroyd, 1994).

The existence of well developed paleosols in the desert regions add weight to the interpretation of wetter-than-present conditions during Earth's past (Smith, 1968, pp. 293-310). Paleosol analysis suggests that water and nutrients were present at levels sufficient to support greater amounts and varieties of vegetation and animal species than at present (Gebhardt, 1988, pp. 3-7). However, serious questions remain as to the impact that these wet-weather conditions had on the formation and preservation of these pluvial lakes. Were these lakes really as large and as deep as has been suggested? Did they last for tens to hundreds of thousands of years over the course of the Pleistocene multiple ice ages?

Death Valley National Monument

In January 1995, I had the opportunity to visit the Death Valley National Monument in southeastern California (Figures 1 and 2). While there, I observed considerable quantities of water which had accumulated in the bolson due to several "exceptional" winter storm systems derived from the Pacific Ocean. Because of the lateral spread of water over the valley floor, it is my approximation that the water was 1 to 2 feet deep at its deepest point in the bolson. I estimate that the water had accumulated over a period of approximately one to two months before my visit to the Death Valley National Monument. I also noted that the pre-existing springs on the valley floor had contributed significant volumes of water from the surrounding mountains. I do not know the final extent of water which accumulated in Death Valley during the 1995 winter season.

What was most interesting to me about the standing water in the Death Valley Bolson was the rapid way in which the water accumulated. Additionally, this was not the first occurrence of standing water on the playa floor. It has been reported that standing water has occurred on the valley floor intermittently throughout the geological past. According to Collier (1990, p. 25), the playa has been covered by ephemeral lakes since the end of the Pleistocene. Many of these intermittent lakes extended over large areas of the valley floor and were tens of feet in depth (Hunt, 1975, pp. 14-15; Collier, 1990, p. 25). More recently, in 1969 the playa filled with water to a depth of 2 to 3 feet (Hunt, 1975, p. 15). These water accumulations usually evaporate over the course of the summer season, when the air temperature consistently rises into the 100°F range. As the water evaporates the dissolved minerals then redeposit both at the surface and in the subsurface. However, surface water is not the main source for the salt and minerals which form on the playa floor.

Groundwater is known to play a key role in forming surface mineral deposits in playas (Rosen 1994; Kendall, 1992). Rosen explained the thick accumulation of evaporite beds found in playas as a function of a constant saline groundwater supply (1994, pp. 6-7). The occurrence of pure salt and/or mineral layers within the playa strata could reflect surface precipitation from groundwater which rose above the playa floor and later drained and/or evaporated away leaving the salts and mineral deposits. Subsequent burial of these precipitated deposits by clastic sediments would serve to create the alternating strata of salt-mineral/clastic deposits observed in these bolsons today. This could then explain the thick accumulations of salt-mineral/clastic strata found in the subsurface of the playa basins, with their formation not a function of large amounts of time but rather as a reflection of groundwater salinity/mineral level and sedimentation rates.

Groundwater is also recognized as the primary factor in creating economic grades and quantities of a variety of minerals and metals. For example, the occurrence of economic quantities of berates/borax is suggested as forming in areas of hot (via volcanism) recirculating groundwater (Gale, 1961, pp. 13-14). The economic deposits of borax at Death Valley fit well within this model.

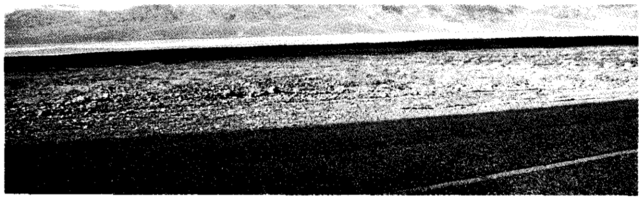

Figure 1. Standing water on the Death Valley floor. The Panamint Mountains are in the background.

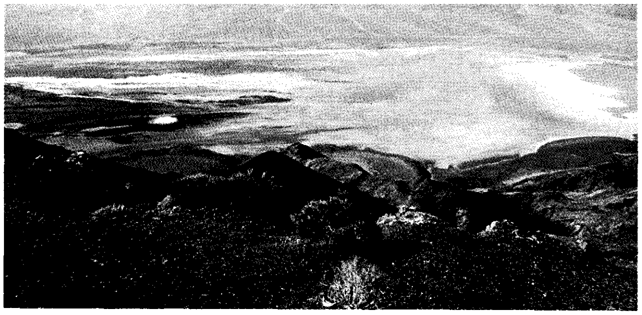

Figure 2. Ephemeral lake from Dante's View. The Panamint Mountains are in the background.

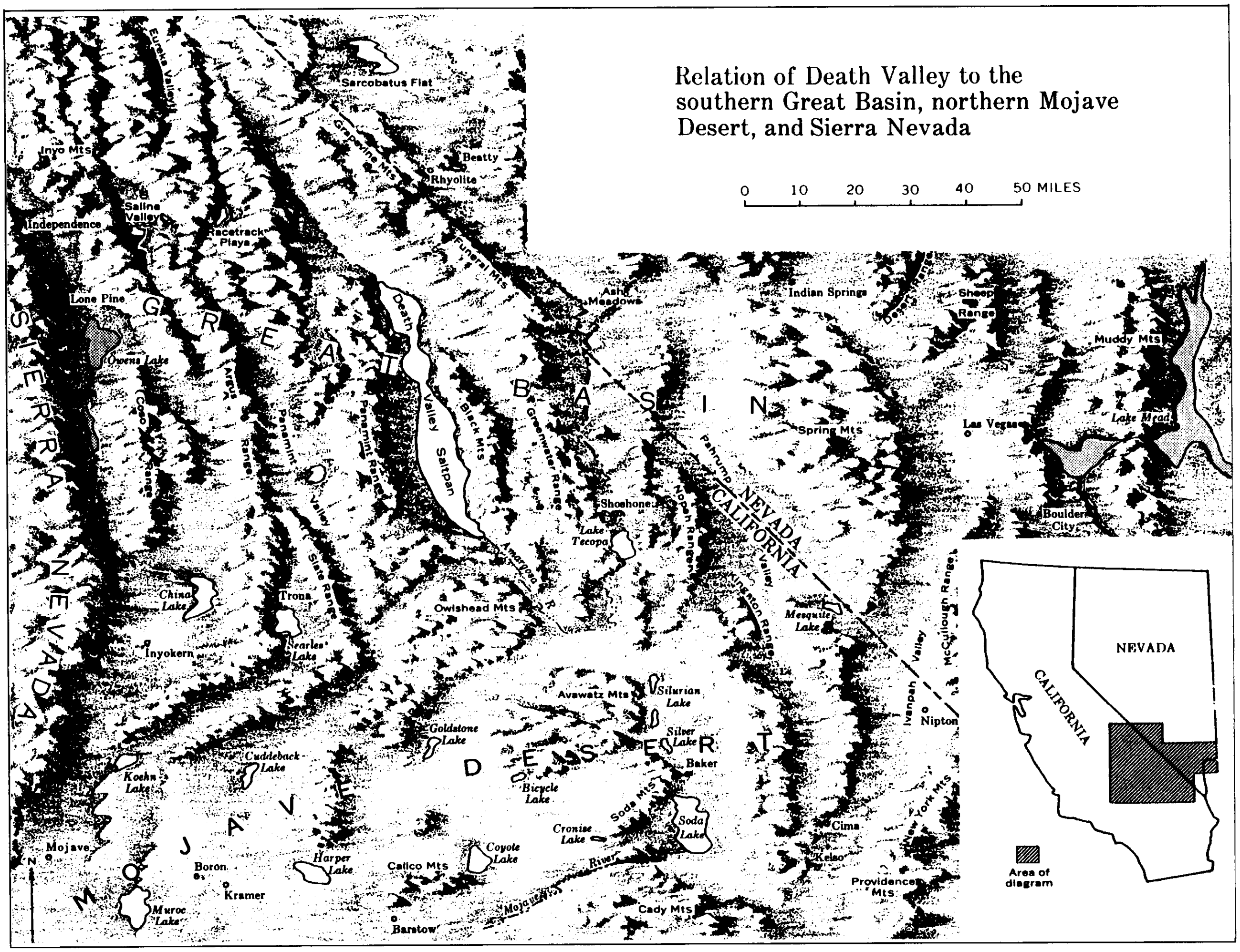

Figure 3A. Shaded relief map showing the Basin and Range topography in the area surrounding the Death Valley National Monument-noted on map as "Death Valley Saltpan" (Modified from Hunt and Mabey, 1966, p. A4). Note the playa locations between the adjacent mountain ridges. Some of these areas are suggested as containing former lakes which spilled over from one another as water conditions allowed.

Historical Perspective

Uniformitarian geologists have suggested that in the prehistoric past Death Valley contained a lake approximately 600 feet deep, 90 miles long, and 6-11 miles wide (Blackwelder, 1954, p. 37; Morrison, 1965, p. 280; Sharp, 1994, p. 102). This prehistoric lake, identified as Lake Manly, is suggested as having formed and developed during the uniformitarian Pleistocene Epoch (Figures 3a and 3b). Evidences to support this proposal are in the form of beach terraces along the sides of the valley and lake deposits on the valley floor (Figure 4). Morrison (1965, p. 280) suggested that Lake Manly correlated with the Tahoe Glaciation (i.e., early Wisconsin), because its deposits and shore features are almost erased by erosion. Hunt and Mabey (1966, p. A71) believed that Lake Manly formed during the Tioga and Tahoe stages of glaciation, which correspond with stages of Lake Bonneville and Lake Lahontan. Hence, all of these pluvial lakes probably existed at the same time—no need for multiple glaciations or vast amounts of time! I suggest that Lake Manly was ephemeral and as such did not exist at the maximum extent or depths suggested for long periods of time. The evidence suggesting that Lake Manly existed at the proposed great size and depth for tens to hundreds of thousands of years is lacking. Hunt and Mabey (1966, p. A71) reported this same observation, they stated:

> The slight erosion and sedimentation record of Lake Manly may mean that the lake was of brief duration, and its level may have fluctuated rapidly. Whatever the cause, this California lake left one of the least distinct and most incomplete records of any Pleistocene lake in the Great Basin . . .

Despite the lack of supporting physical evidence Lake Manly is still believed to have existed over the course of tens of thousands of years during the Pleistocene Ice Ages. The defense of the current uniformitarian position requires an unbelievable amount of erosion to have erased all of the "evidences" of the original long-standing lake. Additionally, the little evidence which does exist in support of Lake Manly does not tend to support its long term existence. The author's position of a smaller scale long term Lake Manly is based on the existing physical evidences of well developed beach terraces and lake bar deposits at lower levels of the bolson and on the lack of extensive physi-

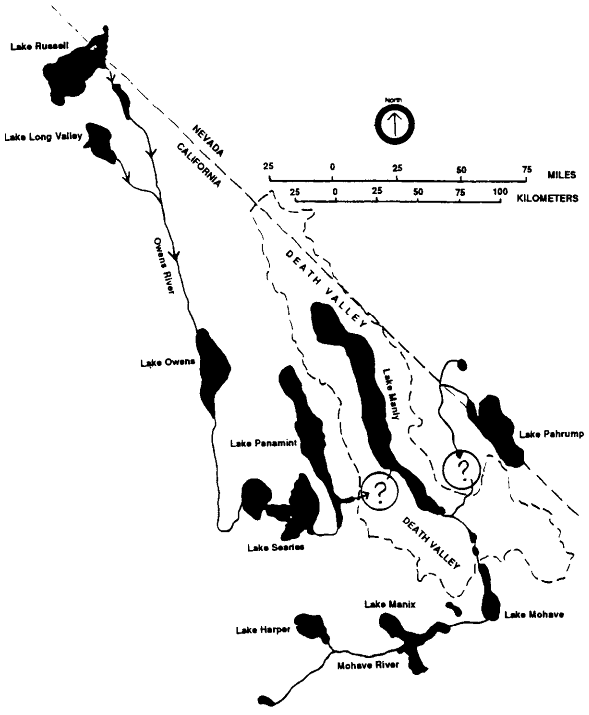

Figure 3B. Pluvial lakes and their interpreted drainage patterns during the Pleistocene. Modified from Morrison (1965, p. 278). Note that most investigators in the past favored a northerly drainage pattern for the filling of Lake Manly based on the tilting of lake deposits and similar fish species (Hunt and Mabey, 1966, p. A72). Other investigators (Morrison, 1965, p. 280; Sharp, 1994, p. 68) have suggested that water flowed from Lake Panamint into Lake Manly via Windgate Pass. Presently, there is no evidence to support this eastward flowing river from Lake Panamint (Blackwelder, 1954, p. 37; Hunt and Mabey, 1966, p. A71).

cal evidences for a much larger lake (i.e., beach terraces, lake deposits along the valley sidewalls, lake deposits on the valley floor, and the lack of erosion on the valley side walls from the lake via subaqueous and subaerial weathering). While evidences of a higher standing lake do exist within Death Valley, the lower sections of the valley provide the most reliable and best supporting evidences of a long term lake (Clements, 1971, p. 49; Hunt and Mabey, 1966, pp. A69-A72; Sharp, 1994, p. 109).

The rapid accumulation of water on the valley floor observed while at Death Valley suggests that with pluvial conditions, a small scale Lake Manly could easily return. The size and depth of the lake would be dependent upon many factors with the two main ones being: 1) the base level of the groundwater table, and 2) the amount of precipitation experienced by the region. While certain evidences do suggest a massive size for the prehistoric Lake Manly, the physical evidences to support its long term existence are questionable or missing.

The Young-Earth Flood Model Approach

This proposal will follow the creationist geological timescale previously suggested by this author (Froede, 1995). The young-earth flood modeler can easily explain the formation and development of pluvial lakes in the southwestern Basin and Range Province of the United States. Originally, during the Antediluvian Timeframe, this region probably existed in a marine environment (Austin, 1994, p. 62: Austin and Wise, 1994, p. 43). With the advent of the Flood the original sediments were eroded, reworked, and subsequently deposited along with additional materials derived from various sources. Regional tectonic events initiated during the middle to later stages of the Flood resulted in the formation of the bolsons and ridges associated with the Basin and Range Province. The Death Valley bolson could have filled with water either from the original Floodwaters which were subsequently flushed and replaced with fresh water (due to a low groundwater base level) or it could have filled by freshwater precipitation associated with the Ice Age Timeframe. Perhaps the accumulations of salt layers both exposed in deposits at the surface and buried in underlying lake sediments could be the salt content remains of the more saline Flood waters.

Volcanic rocks and their associated hydrothermal minerals and metals have also contributed greatly to the economic deposits found at some locations along the valley floor. With the ending of the wet weather conditions toward the close of the Ice Age Timeframe, the pluvial lakes would then have drained and / or evaporated until none of the waters remained. With continuing tectonic and volcanic activity throughout the region, many of the fainter short term evidences of the pluvial lakes were erased (i.e., buried or eroded) thus leaving sporadic evidence of their original existence.

Today, salts and minerals are added to the playa surface via the groundwater (see Rosen, 1994). Hence, the thickness of these deposits is not due to long periods of time, but to the salt / mineral concentrations within the groundwater which precipitate at the playa surface. This young-earth interpretation is based on the same physical evidences observed by the Uniformitarians, but within the time frames suggested by the young-earth Flood model.

Conclusions

The physical evidence in support of a Pleistocene Lake Manly better support an ephemeral lake which existed at its maximum for at most a few hundred years. The lack of extensive well developed terraces and beach deposits along with the few evidences which reflect its existence suggest to me that the large scale deep prehistoric Lake Manly was a very short term feature.

The young-earth Flood model would suggest that this bolson may have originally formed during the Flood and have even contained Floodwaters as those waters drained from the area. With the onset of the single Ice Age, immediately following the Flood, the marine to brackish lake would have experienced a freshwater flush. Minerals and salts originally dissolved within the Floodwaters could have precipitated out in the lake sediments due to the changes in water chemistry associated with the addition of volcanic sediments and freshwater. Eventually the water levels in prehistoric Lake Manly would be controlled by regional groundwater base-level conditions. The lake would have expanded and contracted based on the precipitation experienced by the region throughout the single Ice Age. As the wet weather conditions lessened the

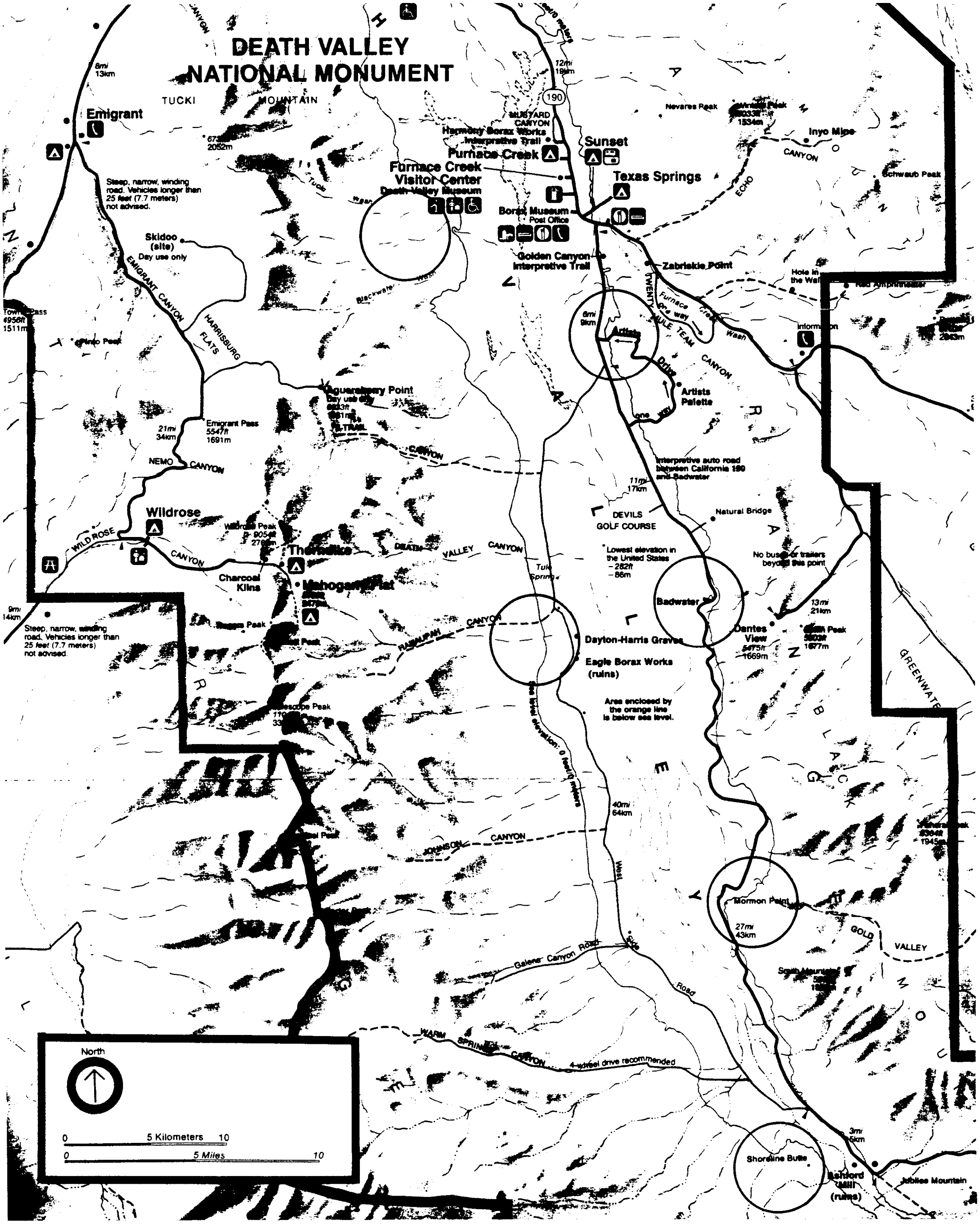

Figure 4. The Death Valley bolson showing locations where clear evidences are present to support the existence of prehistoric Lake Manly. These sites are a mix of both beach terraces and lake deposits. The best evidence for a deep Lake Manly comes from the faint traces etched into the northward face of the Shoreline Butte basalt—shown in most southerly circle. Specifics about these locations can be found in Blackwelder, 1954; Hunt and Mabey, 1966; and Sharp, 1994. Map is modified from the National Park Service map to Death Valley National Monument (1993).

amount of water (both in the form of precipitation and groundwater) feeding into Lake Manly would cause the water levels to drop. Even today, the groundwater across this area continues to flow towards the Death Valley bolson and thus serves to concentrate salts and minerals at this location.

The terraces observed across Death Valley tend to suggest that the lake water levels rose and fell at a steady rate with few periods of stasis (e.g., Shoreline Butte). What is not known is when these higher terraces were formed (e. g., due to draining Floodwaters or to actual freshwater lake levels during the single Ice Age). The best and clearest evidences for the existence of a long term freshwater lake (i.e., Lake Manly) come from the lower levels of the valley and would reflect the longer term freshwater lake which this writer believes existed in the area during the single Ice Age.

Additional possibilities exist in describing and delineating Lake Manly within its associated bolson. The author welcomes additional theories and suggestions as we further define and refine the earth within the young-earth Flood model.

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References

CRSQ-Creation Research Society Quarterly.

Austin, S. A. 1994. Grand Canyon monument to catastrophe. Institute for Creation Research. Santee. CA.

__________ and K. P. Wise. 1994. The pre-Flood/Flood boundary: As defined in Grand Canyon, Arizona and eastern Mojave Desert, California. In Walsh, R. E. (editor). Proceedings of the Third International Conference on Creationism. Creation Science Fellowship. Pittsburgh, PA. pp. 37-47.

Blackwelder, 1954. Pleistocene lakes and drainage in the Mojave region, Southern California. In Jahns, R. H. (editor). Geology of Southern California. Division of Mines Bulletin No. 170. San Francisco. pp. 35-40.

Clements, T. 1971. Geological story of Death Valley. Inland Printing. San Bernardino CA.

Coffin, H. G. and R. H. Brown. 1983. Origin by design. Review and Herald, Washington, D.C.

Collier, M. 1990. An introduction to the geology of Death Valley. Death Valley Historical Association. Death Valley, CA.

Dawson, A. G. 1992. Ice age earth: Late Quaternary geology and climate. Routledge. New York.

Fiero, B. 1986. Geology of the Great Basin. University of Nevada Press. Reno.

Flint, R. F. 1971. Glacial and Quaternary geology. John Wiley. New York.

Froede, C. R., Jr. 1995. A proposal for a creationist geological timescale. *CRSQ* 32:90-94.

Gale, W.A. 1961. Development and present status of the borax industry. In Gould, R. F. (editor). Borax to boranes. Advances in Chemistry Series Number 32. American Chemical Society Applied Publications. Washington, D.C. pp. 13-19.

Gebhardt, C. 1988. Inside Death Valley. Fourth edition. Bookcrafters. Chelsea, MI.

Holroyd, E. W., III. 1994. A remote sensing search for extinct lake shore lines on the Colorado Plateau. In Walsh, R. E. (editor). Technical symposium sessions. Proceedings of the Third International Conference on Creationism. Creation Science Fellowship. Pittsburgh, PA. pp. 243-254.

Hunt, C. B. 1975. Death Valley: Geology, ecology, and archaeology. University of California Press. Los Angeles.

__________ and D. R. Mabey. 1966. Stratigraphy and structure Death Valley, California. U.S. Geological Survey Professional Paper No. 494-A. Washington, D.C.

Kendall, A. C. 1992. Evaporites. In Walker, R. G. and N. P. James (editors). Facies models: Response to sea level change. Geological Association of Canada. St. John's, Newfoundland. pp. 375-409.

Morrison, R. B. 1965. Quaternary geology of the Great Basin. In Wright, H. E., Jr., and D. G. Frey (editors). The Quaternary of the United States. Princeton University Press. Princeton, NJ. pp. 265-285.

National Park Service. 1993. Death Valley. U.S. Department of the Interior. Washington, D.C.

Oard, M. J. 1990. An ice age caused by the Genesis Flood. Institute for Creation Research. San Diego, CA.

Rosen, M. R. 1994. The importance of groundwater in playas: A review of playa classifications and the sedimentology and hydrology of playas. In Rosen, M. R. (editor). Paleoclimate and basin evolution of playa systems. Geological Society of America Special Paper No. 289. Boulder, CO. pp. 1-18.

Sharp, R. P. 1994. A field guide to Southern California. Third edition. Kendall/Hunt. Dubuque, IA.

Smith, G. I. 1968. Late-Quaternary geologic and climatic history of Searles Lake, Southeastern California. In Morrison, R. B. and H. E. Wright, Jr. (editors). Means of correlation of Quaternary successions. Volume 8. Proceedings of the VII Congress. International Association for Quaternary Research. University of Utah Press. Salt Lake City. pp. 293-310.

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Quote — The Origin of the Soul

This distinction between the Platonic and Christian view of man is fundamental, for the deep question at issue is the origin of the soul. Does the soul exist prior to its time, in a transcendent world? Or is each soul a special act of creation in time and place? If the former, then by an action of remembering the soul rescues itself from the world; that is, it rescues itself by an intellectual act. If it is a special creation in time and place, its relation to its cause is more insistent. (The Platonic view delays the question of cause rather than solves it, since the problem arises whether the soul is eternal or is created in the transcendent world.) The soul understood as special creation is by that understanding disallowed its own rescue; some agent separate from the soul is required, by grace centering in Christ as agent. For St. Paul, we are "many members in one body, and . . . have not the same office" in the world since we have "gifts differing according to the grace that is given us." The focus here is upon the responsibilities of the soul in its earthly dimension, responsibilities incumbent by the nature given: the soul's particular, unique, created being. The responsibilities of its full becoming, its realizing a given potential, differs widely from the Platonic concept, which holds that its existence in the world is a decline from a prior completeness. The Platonic concept requires an escape from the world; the Christian concept requires a coming to terms with the world, with the multiplicity of other particular creations.

Montgomery, M. 1990. Virtue and modern shadows of turning: Preliminary agitations. University Press of America. Lanham, MD. p. 18.

PHOTO ESSAY-BACK COVER

Pig or Peccary?

Judging from the photographs, you can tell why this little "critter" is referred to as a *collared* peccary *(Tayassu peccary).* This pig-like, artiodactylous, hoofed mammal has a dark gray coat with a white collar. It ranges from Texas to Paraguay. The collared peccary or javelina (have-ah-lee-nah) is quite common in Big Bend National Park (Wauer, 1980, pp. 77-78).

The creatures are generally shy, but the ones from the herd we photographed, wandered into the tourist area in the Basin within the Chisos Mountains to pose for the camera, eat some grass, and sniff around a bit, quite unconcerned about the people around them (see Figures 1 and 2). Javelinas are very curious; as a matter of fact, one would have entered a parked camper trailer if the screen door had not been closed!

Javelinas have very poor eyesight which would lead you to believe that they are quite helpless. However the peccaries emit a musky scent similar to the smell of a skunk, not thought to be for defense, but for recognition by other javelinas and for marking their territories. The scent gland is located on the rump just above the tail in a position that enables the mammal to rub the gland on rocks, shrubs, etc. Thus the sense of smell is well developed among javelinas, allowing them to detect friend or foe. Judging from their ability to survive, this excellent sense of smell provided by the Creator has served them well.

Reference

Wauer, R. H. 1980. Naturalist's Big Bend. Revised edition. Texas A and M University Press. College Park. pp. 77-78.

Emmett L. Williams
Robert L. Goette

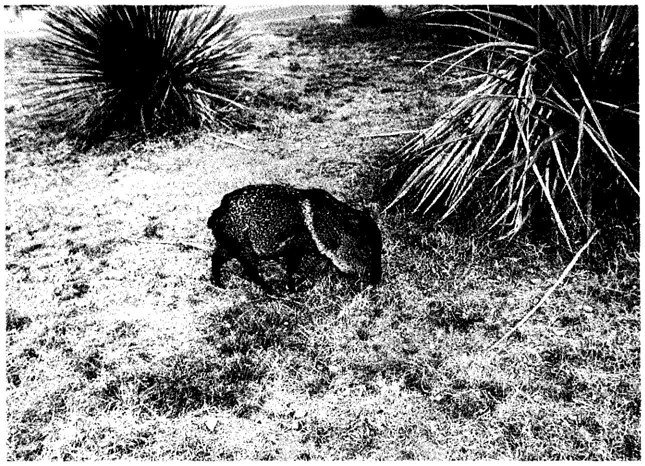

Figure 1.

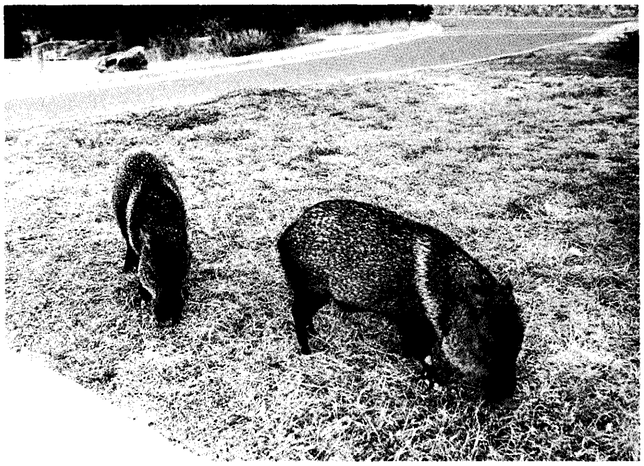

Figure 2.

Quote

I Chronicles 16:30-34

30 Tremble before him, all the earth! The world is firmly established; it cannot be moved.
31 Let the heavens rejoice, let the earth be glad; let them say among the nations, "The LORD reigns!"
32 Let the sea resound and all that is in it; let the fields be jubilant, and everything in them!
33 Then the trees of the forest will sing, they will sing for joy before the LORD, for he comes to judge the earth.
34 Give thanks to the LORD, for he is good; his love endures forever.

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Quote: Populations

The following quotation concerns self-sustaining populations:

> A minimum viable population means the smallest number of individuals that has a reasonable chance of persisting . . . Based on genetic factors, it has been estimated that a population should not fall below 50 breeding adults even for a short time to avoid genetic problems and to keep the chance of extinction acceptably low. . . to maintain a population for a long time, 500 or more breeding individuals are preferable . . . This is sometimes referred to as the 50/500 rule (Bodkins, 1995, pp. 81-82).

Minimum population requirements present an unanswered challenge to evolution in general and punctuated equilibria in particular How did millions of radically new species somehow survive their singular beginning?

Reference

Botkin, Daniel B. 1995. Our natural history. G. P. Putnam's Sons. New York.

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